DIAGNOSTIC MANUAL

N9 and N10 Engine

Navistar, Inc.

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Foreword

Navistar, Inc. is committed to continuous research and development to improve products and introduce technological advances. Procedures, specifications, and parts defined in published technical service literature may be altered.

NOTE: Photo illustrations identify specific parts or assemblies that support text and procedures; other areas in a photo illustration may not be exact.

This manual includes necessary information and specifications for technicians to maintain Navistar diesel engines. See vehicle manuals and Technical Service Information (TSI) bulletins for additional information.

Technical Service Literature	
4328224	N9 and N10 *Engine Operation and Maintenance Manual*
0000004021	N9 and N10 *Engine Service Manual*
0000003721	N9 and N10 *Engine Diagnostic Manual*
0000003481	N9 and N10 *Engine and Aftertreatment Wiring Schematic Form*

Technical Service Literature is revised periodically. If a technical publication is ordered, the latest revision will be supplied.

NOTE: To order technical service literature, contact your International® dealer.

Service Diagnosis

Service diagnosis is an investigative procedure that must be followed to find and correct an engine application problem or an engine problem.

If the problem is engine application, see specific vehicle manuals for further diagnostic information.

If the problem is the engine, see specific *Engine Diagnostic Manual* for further diagnostic information.

Prerequisites for Effective Diagnosis

- Availability of gauges and diagnostic test equipment
- Availability of current information for engine application and engine systems
- Knowledge of the principles of operation for engine application and engine systems
- Knowledge to understand and do procedures in diagnostic and service publications

Technical Service Literature required for Effective Diagnosis

- *Engine Service Manual*
- *Engine Diagnostic Manual*
- Engine and Aftertreatment Wiring Schematic Form
- Service Bulletins

Safety Information

This manual provides general and specific maintenance procedures essential for reliable engine operation and your safety. Since many variations in procedures, tools, and service parts are involved, advice for all possible safety conditions and hazards cannot be stated.

Read safety instructions before doing any service and test procedures for the engine or vehicle. See related application manuals for more information.

Disregard for Safety Instructions, Warnings, Cautions, and Notes in this manual can lead to injury, death or damage to the engine or vehicle.

Safety Terminology

Three terms are used to stress your safety and safe operation of the engine: Warning, Caution, and Note.

Warning: A warning describes actions necessary to prevent or eliminate conditions, hazards, and unsafe practices that can cause personal injury or death.

Caution: A caution describes actions necessary to prevent or eliminate conditions that can cause damage to the engine or vehicle.

Note: A note describes actions necessary for correct, efficient engine operation.

Safety Instructions

Work Area

- Keep work area clean, dry, and organized.
- Keep tools and parts off the floor.
- Make sure the work area is ventilated and well lit.
- Make sure a First Aid Kit is available.

Safety Equipment

- Use correct lifting devices.
- Use safety blocks and stands.

Protective Measures

- Wear protective safety glasses and shoes.
- Wear correct hearing protection.
- Wear cotton work clothing.
- Wear sleeved heat protective gloves.
- Do not wear rings, watches or other jewelry.
- Restrain long hair.

Vehicle

- Make sure the vehicle is in neutral, the parking brake is set, and the wheels are blocked before servicing engine.

- Clear the area before starting the engine.

Engine

- The engine should be operated or serviced only by qualified individuals.
- Provide necessary ventilation when operating engine in a closed area.
- Keep combustible material away from engine exhaust system and exhaust manifolds.
- Install all shields, guards, and access covers before operating engine.
- Do not run engine with unprotected air intakes or exhaust openings. If unavoidable for service reasons, put protective screens over all openings before servicing engine.
- Shut engine off and relieve all pressure in the system before removing panels, housing covers, and caps.
- If an engine is not safe to operate, tag the engine and ignition key.

Fire Prevention

- Make sure charged fire extinguishers are in the work area.

NOTE: Check the classification of each fire extinguisher to ensure that the following fire types can be extinguished.

1. Type A – Wood, paper, textiles, and rubbish
2. Type B – Flammable liquids
3. Type C – Electrical equipment

Batteries

- Always disconnect the main negative battery cable first.
- Always connect the main negative battery cable last.
- Avoid leaning over batteries.
- Protect your eyes.
- Do not expose batteries to open flames or sparks.
- Do not smoke in workplace.

Compressed Air

- Use an OSHA approved blow gun rated at 30 psi (207 kPa).
- Limit shop air pressure to 30 psi (207 kPa).
- Wear safety glasses or goggles.
- Wear hearing protection.
- Use shielding to protect others in the work area.
- Do not direct compressed air at body or clothing.

Tools

- Make sure all tools are in good condition.
- Make sure all standard electrical tools are grounded.

- Check for frayed power cords before using power tools.

Fluids Under Pressure

- Use extreme caution when working on systems under pressure.
- Follow approved procedures only.

Fuel

- Do not over fill the fuel tank. Over fill creates a fire hazard.
- Do not smoke in the work area.
- Do not refuel the tank when the engine is running.

Removal of Tools, Parts, and Equipment

- Reinstall all safety guards, shields, and covers after servicing the engine.
- Make sure all tools, parts, and service equipment are removed from the engine and vehicle after all work is done.

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SCR (Temperature Sensor Module).....1907
SCRIT (Selective Catalyst Reduction Intake Temperature) Sensor.....1954
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TC2CIT (Turbocharger 2 Compressor Intake Temperature).....1978
TC2WG (Turbocharger 2 Wastegate Position).....1997
TOSS (Transmission Output Shaft Speed) Sensor.....2008
VREF (Voltage Reference).....2025
WIF Sensor (Water In Fuel).....2074

Diagnostic Trouble Code (DTC's) List

SPN	FMI	Sub-section	Condition Description
27	0	EGR (page 1074)	EGRP fault: over temperature
27	14	EGR (page 1074)	EGR internal circuit failure
51	3	ETP (page 1187)	ETP signal Out of Range HIGH
51	4	ETP (page 1187)	ETP signal Out of Range LOW
51	7	ETP (page 1187)	ETP does not agree with commanded position
91	2	APP (page 402)	APP1 and APP2 signal conflict
91	3	APP (page 402)	APP1 signal Out of Range HIGH
91	4	APP (page 402)	APP1 signal Out of Range LOW
94	0	EFP (page 1065)	Fuel Delivery Pressure above Critical
94	1	EFP (page 1065)	Fuel Delivery Pressure below Critical
94	3	FDP (page 1247)	FDP signal Out of Range HIGH
94	4	FDP (page 1247)	FDP signal Out of Range LOW
94	17	FDP (page 1247)	Fuel Delivery Pressure below minimum
94	18	FDP (page 1247)	Fuel Delivery Pressure below min during cranking
96	3	FLI (page 1265)	Fuel Level signal Out of Range HIGH
96	4	FLI (page 1265)	Fuel Level signal Out of Range LOW
96	19	FLI (page 1265)	Fuel Level not detected on J1939
100	1	EWPS (page 1210)	Engine Oil System below Critical Pressure
100	3	EOP (page 1152)	EOP signal Out of Range HIGH
100	4	EOP (page 1152)	EOP signal Out of Range LOW
100	18	EWPS (page 1210)	Engine Oil System below Warning Pressure
102	2	IMP (page 1322)	IMP signal erratic, intermittent, or incorrect
102	3	IMP (page 1322)	IMP signal Out of Range HIGH
102	4	IMP (page 1322)	IMP signal Out of Range LOW
102	7	IMP (page 1322)	IMP signal not responding as expected
102	10	IMP (page 1322)	Boost slow response fault
102	16	IMP (page 1322)	Overboost
102	18	IMP (page 1322)	Underboost
105	2	IMT (page 1349)	IMT signal Erratic, Intermittent, or Incorrect
105	3	IMT (page 1349)	IMT signal Out of Range HIGH
105	4	IMT (page 1349)	IMT signal Out of Range LOW
108	2	ECM (page 1000)	BARO signal erratic, intermittent, or incorrect
108	3	ECM (page 1000)	BARO signal Out of Range HIGH
108	4	ECM (page 1000)	BARO signal Out of Range LOW

SPN	FMI	Sub-section	Condition Description
110	0	EWPS(page 1210)	Engine Cooling System above Critical Temperature
110	2	ECT1 (page 1033)	ECT1 signal erratic, intermittent, or incorrect
110	3	ECT1 (page 1033)	ECT1 signal Out of Range HIGH
110	4	ECT1 (page 1033)	ECT1 signal Out of Range LOW
110	15	EWPS (page 1210)	Engine Cooling System above Warning Temperature
110	16	EWPS (page 1210)	ECT1 stuck in range High
110	17	ECT1 (page 1033)	ECT1 stuck in range Low
110	18	ECT1 (page 1033)	Engine Coolant System Below closed loop minimum temperature
111	1	EWPS (page 1210)	ECL below Warning / Critical Level
111	2	EWPS (page 1210)	ECL signal erratic, intermittent, or incorrect
132	0	MAF (page 1782)	Engine Intake Air Mass Flow Rate High
132	1	MAF (page 1782)	Engine Intake Air Mass Flow Rate Low
132	4	MAF (page 1782)	MAF signal Out of Range LOW
132	11	MAF (page 1782)	MAF Sensor Calibration – Insufficient number of data points
132	13	MAF (page 1782)	MAF Sensor Calibration Needed
132	14	MAF (page 1782)	MAF Sensor Calibration Failed
132	31	MAF (page 1782)	MAF Frequency out of range HIGH
158	15	ECM (page 1000)	Battery Voltage above 16 volts
158	17	ECM (page 1000)	Battery Voltage below 9 volts
164	0	ICP (page 1286)	ICP above KOEO Spec
164	1	ICP (page 1286)	ICP Unable to Build During Engine Cranking
164	3	ICP (page 1286)	ICP signal Out of Range HIGH
164	4	ICP (page 1286)	ICP signal Out of Range LOW
164	15	ICP (page 1286)	ICP too high during test
164	16	ICP (page 1286)	ICP above desired level
164	17	ICP (page 1286)	ICP unable to build during test
164	18	ICP (page 1286)	ICP below desired level
171	2	AAT (page 143)	AAT signal erratic, intermittent, or incorrect
171	3	AAT (page 143)	AAT Signal Out of Range HIGH
171	4	AAT (page 143)	AAT Signal Out of Range LOW
172	2	MAF (page 1782)	IAT Signal Erratic, Intermittent, or Incorrect
172	3	MAF (page 1782)	IAT signal Out of Range HIGH
172	4	MAF (page 1782)	IAT Signal Out of Range LOW
173	2	EGT (page 1115)	EGT signal erratic, intermittent, or incorrect
173	3	EGT (page 1115)	EGT signal Out of Range HIGH

SPN	FMI	Sub-section	Condition Description
173	4	EGT (page 1115)	EGT signal Out of Range LOW
175	2	EOT (page 1163)	EOT signal erratic, intermittent, or incorrect
175	3	EOT (page 1163)	EOT signal Out of Range HIGH
175	4	EOT (page 1163)	EOT signal Out of Range LOW
175	7	EOT (page 1163)	EOT not warming along with engine
175	15	EWPS (page 1210)	Engine Oil System above Warning Temperature
188	0	Engine (page 1132)	Engine Low Idle RPM above normal
188	1	Engine (page 1132)	Engine Low Idle RPM below normal
190	0	EWPS (page 1210)	Engine Overspeed - Most Severe Level
191	3	TOSS (page 2008)	TOSS/VSS signal out of range HIGH
191	4	TOSS (page 2008)	TOSS/VSS signal out of range LOW
191	5	TOSS (page 2008)	TOSS/VSS Open Circuit fault
191	14	TOSS (page 2008)	TOSS/VSS Error invalid signal
521	2	BODY (page 428)	Brake applied while APP applied
593	31	EWPS (page 1210)	Engine stopped by IST
596	19	BODY (page 428)	Cruise Control Enable Switch not detected on J1939
597	2	BODY (page 428)	Brake switch or circuit fault
597	19	BODY (page 428)	Brake Switch not detected on J1939
609	19	DCU (page 475)	ACM (CES) not detected on J1939
628	12	ECM (page 1000)	ECM Memory Error
629	0	ECM (page 1000)	ECM Error - CPU Load Excessively HIGH
629	8	ECM (page 1000)	ECM Error - Engine Off Timer fault
629	12	ECM (page 1000)	ECM Internal chip Error
636	2	CMP (page 470)	CMP and CKP Synchronization Error
636	7	CMP (page 470)	CMP to CKP incorrect reference
637	8	CKP (page 465)	CKP signal noise
637	10	CKP (page 465)	CKP signal Inactive
639	14	J1939 (page 1779)	J1939 Data Link Error (ECM unable to transmit)
651	4	INJ (page 1365)	Injector 1 open coil - short circuit
651	5	INJ (page 1365)	Injector 1 open coil - open circuit
651	7	INJ (page 1365)	Injector 1 Spool Motion Compensation Max Authority Reached
651	14	INJ (page 1365)	Injector 1 Fuel quantity / timing error
652	4	INJ (page 1365)	Injector 2 open coil - short circuit
652	5	INJ (page 1365)	Injector 2 open coil - open circuit

SPN	FMI	Sub-section	Condition Description
652	7	INJ (page 1365)	Injector 2 Spool Motion Compensation Max Authority Reached
652	14	INJ (page 1365)	Injector 2 Fuel quantity / timing error
653	4	INJ (page 1365)	Injector 3 open coil - short circuit
653	5	INJ (page 1365)	Injector 3 open coil - open circuit
653	7	INJ (page 1365)	Injector 3 Spool Motion Compensation Max Authority Reached
653	14	INJ (page 1365)	Injector 3 Fuel quantity / timing error
654	4	INJ (page 1365)	Injector 4 open coil - short circuit
654	5	INJ (page 1365)	Injector 4 open coil - open circuit
654	7	INJ (page 1365)	Injector 4 Spool Motion Compensation Max Authority Reached
654	14	INJ (page 1365)	Injector 4 Fuel quantity / timing error
655	4	INJ (page 1365)	Injector 5 open coil - short circuit
655	5	INJ (page 1365)	Injector 5 open coil - open circuit
655	7	INJ (page 1365)	Injector 5 Spool Motion Compensation Max Authority Reached
655	14	INJ (page 1365)	Injector 5 Fuel quantity / timing error
656	4	INJ (page 1365)	Injector 6 open coil - short circuit
656	5	INJ (page 1365)	Injector 6 open coil - open circuit
656	7	INJ (page 1365)	Injector 6 Spool Motion Compensation Max Authority Reached
656	14	INJ (page 1365)	Injector 6 Fuel quantity / timing error
679	3	IPR (page 1768)	IPR short to PWR
679	4	IPR (page 1768)	IPR Open or short to GND
729	3	IAHC (page 1272)	IAHC short to PWR
729	4	IAHC (page 1272)	IAHC short to GND
729	5	IAHC (page 1272)	IAHC open load / circuit
729	18	IAHC (page 1272)	IAH Monitor fault: Lack of Heat in the Intake Manifold
931	3	EFP (page 1065)	EFP short to PWR
931	4	EFP (page 1065)	EFP open load / circuit or short to GND
974	3	RAPP (page 1904)	Remote APP signal Out of Range HIGH
1136	0	ECM (page 1000)	ECM Error – over temperature
1173	2	TC2CIT (page 1978)	TC2CIT signal erratic, intermittent, or incorrect
1173	3	TC2CIT (page 1978)	TC2CIT signal Out of Range HIGH
1173	4	TC2CIT (page 1978)	TC2CIT signal Out of Range LOW

SPN	FMI	Sub-section	Condition Description
1173	16	TC2CIT (page 1978)	TC2CIT signal above desired (Low Pressure CAC Interstage under cooling)
1189	3	TC2WC (page 1997)	TC2WC short to PWR
1189	4	TC2WC (page 1997)	TC2WC Open or short to GND
1209	0	AMS (page 381)	EBP above desired level
1209	1	EBP (page 914)	EBP below desired level
1209	2	EBP (page 914)	EBP signal erratic, intermittent, or incorrect
1209	3	EBP (page 914)	EBP signal Out of Range HIGH
1209	4	EBP (page 914)	EBP signal Out of Range LOW
1209	7	AMS (page 381)	EBP signal not responding as expected
1322	31	Engine (page 1132)	Misfire - Multiple Cylinders
1323	31	Engine (page 1132)	Misfire - Cylinder 1
1324	31	Engine (page 1132)	Misfire - Cylinder 2
1325	31	Engine (page 1132)	Misfire - Cylinder 3
1326	31	Engine (page 1132)	Misfire - Cylinder 4
1327	31	Engine (page 1132)	Misfire - Cylinder 5
1328	31	Engine (page 1132)	Misfire - Cylinder 6
1378	31	EWPS (page 1210)	Change Engine Oil Service Interval
1387	31	ECM (page 1000)	Altitude Reference Adder Fault
1569	31	DEFTLT (page 746)	SCR Tamperproof Warning & Protection System Inducement Severe
1659	20	ECT1 (page 1033)	ECT1 below expected: Check Thermostat
1761	1	DEFTLT (page 746)	DEFTL Inducement (Level 3 - 4)
1761	3	DEFTLT (page 746)	DEFTL signal Out of Range HIGH
1761	4	DEFTLT (page 746)	DEFTL signal Out of Range LOW
1761	10	DEFTLT (page 746)	DEF Level abnormal rate of change
1761	11	DEFTLT (page 746)	DEFTL signal erratic, intermittent, or incorrect
1761	17	DEFTLT (page 746)	DEFTL Inducement Level 1
1761	18	DEFTLT (page 746)	DEFTL Inducement Level 2
1761	19	DEFTLT (page 746)	DEFTL not detected on J1939
2623	3	APP (page 402)	APP2 signal Out of Range HIGH
2623	4	APP (page 402)	APP2 signal Out of Range LOW
2630	2	CACOT (page 439)	CACOT signal erratic, intermittent, or incorrect
2630	3	CACOT (page 439)	CACOT signal Out of Range HIGH
2630	4	CACOT (page 439)	CACOT signal Out of Range LOW
2630	16	CACOT (page 439)	CACOT Undercooling

SPN	FMI	Sub-section	Condition Description
2659	10	AMS (page 381)	EGR Slow Response Fault
2659	14	AMS (page 381)	EGR System flow rate error during Air Management Test
2659	20	AMS (page 381)	EGR High Flow Rate detected
2659	21	AMS (page 381)	EGR Low Flow Rate detected
2791	2	EGR (page 1074)	EGR feedback communication fault
2791	3	EGR (page 1074)	EGRV supply voltage is too HIGH
2791	4	EGR (page 1074)	EGRV supply voltage is too LOW
2791	7	EGR (page 1074)	EGR Valve unable to achieve commanded position
2791	8	EGR (page 1074)	EGR valve not receiving ECM PWM signal
2791	12	EGR (page 1074)	EGR Valve Internal self test fault
2791	14	EGR (page 1074)	EGR valve Initialization Fault
2797	6	INJ (page 1365)	Injector Control Group 1 - short circuit (INJ 1, 2, 3)
2798	6	INJ (page 1365)	Injector Control Group 2 - short circuit (INJ 4, 5, 6)
3031	2	DEFTLT (page 746)	DEFTT signal erratic, intermittent or incorrect
3031	3	DEFTLT (page 746)	DEFTT signal Out of Range HIGH
3031	4	DEFTLT (page 746)	DEFTT signal Out of Range LOW
3055	2	INJ (page 1365)	ICP / IPR Adaptation In-Range Fault
3061	31		CSER Exhaust warm up time fault
3216	4	NO_X (page 1827)	NOxIN signal Out of Range LOW
3216	10	NO_X (page 1827)	NOxIN signal abnormal rate of change
3216	13	NO_X (page 1827)	NOxIN Out of Calibration
3216	19	NO_X (page 1827)	NOxIN not detected on J1939
3216	20	NO_X (page 1827)	NOxIN signal drifted HIGH
3216	21	NO_X (page 1827)	NOxIN signal drifted LOW
3218	2	NO_X (page 1827)	NOxIN power supply signal erratic, intermittent or incorrect
3226	2	NO_X (page 1827)	NOxOUT signal erratic, intermittent or incorrect
3226	4	NO_X (page 1827)	NOxOUT signal Out of Range LOW
3226	10	NO_X (page 1827)	NOxOUT signal abnormal rate of change
3226	13	NO_X (page 1827)	NOxOUT Out of Calibration
3226	19	NO_X (page 1827)	NOxOUT not detected on J1939
3226	20	NO_X (page 1827)	NOxOUT signal drifted HIGH
3226	21	NO_X (page 1827)	NOxOUT signal drifted LOW
3228	2	NO_X (page 1827)	NOxOUT power supply signal erratic, intermittent or incorrect
3242	0	DPFIT (page 876)	DPFIT above Critical Temperature
3242	2	DPFIT (page 876)	DPFIT signal erratic, intermittent, or incorrect

SPN	FMI	Sub-section	Condition Description
3242	3	DPFIT (page 876)	DPFIT signal Out of Range HIGH
3242	4	DPFIT (page 876)	DPFIT signal Out of Range LOW
3242	15	DPFIT (page 876)	DPFIT above Warning Temperature
3242	16	DPFIT (page 876)	DPFIT above Maximum Temperature
3246	0	DPFOT (page 898)	DPFOT above Critical Temperature
3246	2	DPFOT (page 898)	DPFOT signal erratic, intermittent, or incorrect
3246	3	DPFOT (page 898)	DPFOT signal Out of Range HIGH
3246	4	DPFOT (page 898)	DPFOT signal Out of Range LOW
3246	15	DPFOT (page 898)	DPFOT above Warning Temperature
3246	16	DPFOT (page 898)	DPFOT above Maximum Temperature
3251	0	AFT (page 156)	DPFDP excessively HIGH (Plugged filter)
3251	2	DPFDP / DPFOP (page 844)	DPFDP signal erratic, intermittent, or incorrect
3251	3	DPFDP / DPFOP (page 844)	DPFDP signal Out of Range HIGH
3251	4	DPFDP / DPFOP (page 844)	DPFDP signal Out of Range LOW
3251	15	AFT (page 156)	DPF Soot Load - Least Severe Level
3251	16	AFT (page 156)	DPF Soot Load - Moderately Severe Level
3361	2	DEF: SP (page 698)	DEFSP signal erratic, intermittent or incorrect
3361	3	DEF: SP (page 698)	DEFSP signal Out of Range HIGH
3361	4	DEF: SP (page 698)	DEFSP signal Out of Range LOW
3362	31	DEF: SP (page 698)	DEF dosing unable to prime
3363	3	DEFTHC (page 727)	DEF Tank Heater Control Valve short to PWR
3363	4	DEFTHC (page 727)	DEF Tank Heater Control Valve short to GND
3363	7	DEFTHC (page 727)	DEF Tank Heater Control Valve Mechanical system not responding
3363	16	DEFTHC (page 727)	DEF Tank Heater Control Valve stuck open fault
3363	18	DEFTHC (page 727)	DEF Tank Heater Control Valve unable to thaw frozen DEF
3364	31	ETP (page 1187)	Intake Throttle Valve short circuit fault
3471	1	AFTFPC (page 279)	AFT Fuel Pressure 1 below desired (Low system pressure)
3471	7	AFTFPC (page 279)	AFT Fuel Doser Valve not responding as expected
3471	10	AFTFPC (page 279)	AFT Fuel Pressure incorrect dosing pressure multiple events
3479	3	AFTFPC (page 279)	AFT Fuel Doser Valve Short to PWR
3479	4	AFTFPC (page 279)	AFT Fuel Doser Valve Short to GND
3479	5	AFTFPC (page 279)	AFT Fuel Pressure Valve Open or Short to GND low side
3479	6	AFTFPC (page 279)	AFT Fuel Doser Valve High Side Short circuit
3480	3	AFTFIS (page 226)	AFTFP1 signal Out of Range HIGH
3480	4	AFTFIS (page 226)	AFTFP1 signal Out of Range LOW

SPN	FMI	Sub-section	Condition Description
3482	3	AFTFSV (page 205)	AFT Fuel Enable Control Valve short to PWR
3482	4	AFTFSV (page 205)	AFT Fuel Enable Control Valve open or short to GND
3509	3	VREF (page 2025)	VREF 1 voltage above maximum
3509	4	VREF (page 2025)	VREF 1 voltage below minimum
3510	3	VREF (page 2025)	VREF 2 voltage above maximum
3510	4	VREF (page 2025)	VREF 2 voltage below minimum
3511	3	VREF (page 2025)	VREF 3 voltage above maximum
3511	4	VREF (page 2025)	VREF 3 voltage below minimum
3521	11	DEFTLT (page 746)	Improper Reductant in DEF Tank
3556	0	AFTFP2 (page 257)	AFT Fuel Pressure 2 excessively high (Restricted injection)
3556	1	AFTFP2 (page 257)	AFT Fuel Pressure 2 below desired (Possible system leak)
3556	7	AFTFP2 (page 257)	AFT Fuel Injector not responding as expected
3610	2	DPFDP / DPFOP (page 844)	DPFOP signal erratic, intermittent or incorrect
3610	3	DPFDP / DPFOP (page 844)	DPFOP signal Out of Range HIGH
3610	4	DPFDP / DPFOP (page 844)	DPFOP signal Out of Range LOW
3659	4	INJ (page 1365)	Injector 1 close coil – short circuit
3659	5	INJ (page 1365)	Injector 1 close coil – open circuit
3660	4	INJ (page 1365)	Injector 2 close coil – short circuit
3660	5	INJ (page 1365)	Injector 2 close coil – open circuit
3661	4	INJ (page 1365)	Injector 3 close coil – short circuit
3661	5	INJ (page 1365)	Injector 3 close coil – open circuit
3662	4	INJ (page 1365)	Injector 4 close coil: short circuit
3662	5	INJ (page 1365)	Injector 4 close coil – open circuit
3663	4	INJ (page 1365)	Injector 5 close coil – short circuit
3663	5	INJ (page 1365)	Injector 5 close coil – open circuit
3664	4	INJ (page 1365)	Injector 6 close coil – short circuit
3664	5	INJ (page 1365)	Injector 6 close coil – open circuit
3695	2	AFT (page 156)	DPF Regen Inhibit Switch erratic, intermittent or incorrect
3695	19	AFT (page 156)	DPF Regen Inhibit Switch status not detected on J1939
3703	31	AFT (page 156)	DPF Active Regeneration Inhibited Due to Inhibit Switch
3713	31	AFT (page 156)	DPF Active Regeneration Inhibited Due to System Timeout
3719	0	AFT (page 156)	DPF Soot Load - Highest (level 3/3)
3719	15	AFT (page 156)	DPF Soot Load - Lowest (level 1/3)
3719	16	AFT (page 156)	DPF Soot Load - Moderate (level 2/3)
3750	31	AFT (page 156)	DPF Regen inhibited due to low exhaust temperatures

SPN	FMI	Sub-section	Condition Description
3936	0	EWPS (page 1210)	DPF Soot Load – Severe De-Rate
3936	14	AFT (page 156)	DOC/DPF Temperature module (Incorrect Part)
3936	15	AFT (page 156)	DPF System above Warning Pressure
3936	16	AFT (page 156)	DPF System above Maximum Pressure
4077	3	AFTFP2 (page 257)	AFTFP2 signal Out of Range HIGH
4077	4	AFTFP2 (page 257)	AFTFP2 signal Out of Range LOW
4094	31	DEFTLT (page 746)	DEF below acceptable quality
4192	3	WIF (page 2074)	WIF signal Out of Range HIGH
4192	4	WIF (page 2074)	WIF signal Out of Range LOW
4192	5	WIF (page 2074)	WIF signal Open or Short to PWR
4192	31	WIF (page 2074)	Water in Fuel Detected
4227	7	CCOSS (page 458)	CC Oil Separator: Not spinning
4257	7	INJ (page 1365)	Injector Coking Compensation Factor Reached Maximum Authority
4257	16	INJ (page 1365)	Multiple Injector High Flow fault
4257	18	INJ (page 1365)	Multiple Injector Low Flow fault
4287	0	ECBP (page 972)	ECBP above desired level
4287	1	ECBP (page 972)	ECBP below desired level
4287	3	ECBP (page 972)	ECBP signal Out of Range HIGH
4287	4	ECBP (page 972)	ECBP signal Out of Range LOW
4334	2	DEF: AP (page 591)	DEFLP signal erratic, intermittent or incorrect
4334	3	DEF: AP (page 591)	DEFAP signal Out of Range HIGH
4334	4	DEF: AP (page 591)	DEFAP signal Out of Range LOW
4334	16	DEF: AP (page 591)	DEF Absolute Pressure above maximum
4334	18	DEF: AP (page 591)	DEF Absolute Pressure below normal
4337	2	DEF: AP (page 591)	DEF Dosing Unit Temperature - Data Erratic, Intermittent, or Incorrect
4337	10	DEF: AP (page 591)	DEF Dosing Unit Temperature abnormal rate of change
4340	3	DEFSLH (page 629)	DEF Supply Line Heater Short to PWR
4340	5	DEFSLH (page 629)	DEF Supply Line Heater open load/circuit
4342	3	DEFRLH (page 645)	DEF Return Line Heater Short to PWR
4342	5	DEFRLH (page 645)	DEF Return Line Heater open load/circuit
4344	3	DEFPLH (page 677)	DEF Pressure Line Heater Short to PWR
4344	5	DEFPLH (page 677)	DEF Pressure Line Heater open load/circuit
4360	0	SCRIT (page 1954)	SCRIT above Critical Temperature
4360	2	SCRIT (page 1954)	SCRIT signal erratic, intermittent or incorrect

SPN	FMI	Sub-section	Condition Description
4360	3	SCRIT (page 1954)	SCRIT signal Out of Range HIGH
4360	4	SCRIT (page 1954)	SCRIT signal Out of Range LOW
4360	16	SCRIT (page 1954)	SCRIT above Maximum Temperature
4363	0	SCROT (page 1968)	SCROT above Critical Temperature
4363	2	SCROT (page 1968)	SCROT signal erratic, intermittent or incorrect
4363	3	SCROT (page 1968)	SCROT signal Out of Range HIGH
4363	4	SCROT (page 1968)	SCROT signal Out of Range LOW
4364	18	SCR (page 1907)	Low NOx Conversion Detected
4376	3	DEF: RCV (page 662)	DEF Reverting Control Valve short to PWR
4376	4	DEF: RCV (page 662)	DEF Reverting Control Valve short to GND
4376	7	DEF: RCV (page 662)	DEF Reverting Control Valve - Mechanical system not responding or out of adjustment
4377	2	Ammonia (page 338)	NH3 in range stuck fault
4377	3	Ammonia (page 338)	NH3 Sensor signal Out of Range HIGH
4377	4	Ammonia (page 338)	NH3 operation fault
4377	12	Ammonia (page 338)	NH3 internal chip error
4377	13	Ammonia (page 338)	NH3 operation fault
4377	19	Ammonia (page 338)	NH3 Sensor Module not detected on j1939
4380	2	Ammonia (page 338)	NH3 signal erratic, intermittent, or incorrect
4382	10	Ammonia (page 338)	NH3 sensor Heater abnormal rate of change
4752	4	EGR (page 1074)	EGR Cooler Efficiency: EGR Outlet Temp above expected
4765	2	DOCIT (page 830)	DOCIT signal erratic, intermittent, or incorrect
4765	3	DOCIT (page 830)	DOCIT signal Out of Range HIGH
4765	4	DOCIT (page 830)	DOCIT signal Out of Range LOW
4765	16	DOCIT (page 830)	DOCIT Above Maximum Temperature
4766	15	DPFIT (page 876)	DPFIT Above Warning Temperature
4766	16	DPFIT (page 876)	DPFIT Above Maximum Temperature
4792	7	SCR (page 1907)	SCR Catalyst System - Mechanical system not responding or out of adjustment
4792	14	SCR (page 1907)	SCR Temperature Module (Incorrect Part)
4794	31	SCR (page 1907)	SCR Catalyst System Missing
4795	31	AFT (page 156)	DPFDP excessively LOW (sensor/circuit fault or missing DPF)
4796	31	AFT (page 156)	Diesel Oxidation Catalyst Missing
5024	10	NOx (page 1827)	NOxIN Sensor Heater abnormal rate of change
5031	10	NOx (page 1827)	NOxOUT Sensor Heater not reading correctly
5109	3	DCU (page 475)	DCU battery voltage above 17 volts

SPN	FMI	Sub-section	Condition Description
5109	4	DCU (page 475)	DCU battery voltage below 10 volts
5109	19	DCU (page 475)	DCU not detected on J1939
5246	15	DEFTLT (page 746)	SCR Tamper Proof Inducement Level 1 status
5298	17	AFT (page 156)	DOC Efficiency fault, Temperature below minimum Regen Aborted
5298	18	AFT (page 156)	DOC Efficiency fault, Temperature below minimum
5302	18	Ammonia (page 338)	Post SCR NH3 Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level
5319	31	AFT (page 156)	DPF incomplete regeneration
5394	2	DEF: DU (page 554)	DEF Dosing below desired (Low NOx conversion across SCR)
5394	5	DEF: DU (page 554)	DEF Doser Valve open load/circuit
5394	7	DEF: DU (page 554)	DEF Dosing Unit - Mechanical system not responding
5395	0	Engine (page 1132)	Engine unable to achieve desired idle torque (too high)
5395	1	Engine (page 1132)	Engine unable to achieve desired idle torque (too low)
5397	31	DPF (page 840)	DPF regenerations are occurring too frequently
5456	2	AFTFIS (page 226)	AFTFIT signal erratic, intermittent, or incorrect
5456	3	AFTFIS (page 226)	AFTFT signal Out of Range HIGH
5456	4	AFTFIS (page 226)	AFTFT signal Out of Range LOW
5491	3	DEF: LHR (page 570)	DEF Line Heater Relay Open or short to PWR
5491	4	DEF: LHR (page 570)	DEF Line Heater Relay short to GND
5541	2	EBPV (page 930)	TC1TOP signal erratic, intermittent or incorrect
5541	3	EBPV (page 930)	TC1TOP signal Out of Range HIGH
5541	4	EBPV (page 930)	TC1TOP signal Out of Range LOW
5542	15	EBPV (page 930)	TC1TOP Above Desired
5542	17	EBPV (page 930)	TC1TOP Below Desired
5543	3	EBPV (page 930)	EBPC short to PWR
5543	4	EBPV (page 930)	EBPC short to GND
5543	5	EBPV (page 930)	EBPC open load / circuit
5742	3	DOC (page 800)	DPF Thermocouple Controller Out of Range HIGH
5742	4	DOC (page 800)	DPF Thermocouple Controller Out of Range LOW
5742	11	DOC (page 800)	DPF Thermocouple Controller signal erratic, intermittent, or incorrect
5742	16	DOC (page 800)	DPF Thermocouple Controller above Maximum Temperature
5742	19	DOC (page 800)	DOC/DPF Temperature module not detect J1939
5743	3	SCR (page 1907)	SCR Thermocouple Controller Out of Range HIGH
5743	4	SCR (page 1907)	SCR Thermocouple Controller Out of Range LOW

SPN	FMI	Sub-section	Condition Description
5743	11	SCR (page 1907)	SCR Thermocouple Controller signal erratic, intermittent, or incorrect
5743	16	SCR (page 1907)	SCR Thermocouple Controller above Maximum Temperature
5743	19	SCR (page 1907)	SCR Temperature module not detect J1939
5745	3	DEFSMH (page 508)	DEF Supply Module Heater Out of Range HIGH
5745	4	DEFSMH (page 508)	DEF Supply Module Heater Out of Range LOW
5745	18	DEFSMH (page 508)	DEF Dosing Unit Heater below Warning Temperature
5746	3	DEF: SMH Relay (page 782)	DEF Supply Module Heater Relay short to PWR
5746	4	DEF: SMH Relay (page 782)	DEF Supply Module Heater Relay short to GND
5798	2	DEFSMH (page 508)	DEF Supply Module Heater Temperature erratic, intermittent or incorrect
5798	10	DEFSMH (page 508)	DEF Supply Module Heater Temperature abnormal rate of change
520668	31	DEF (page 497)	Controller Adaptation Outer Limits Reached (Low Reductant Delivery)
520669	31	DEF (page 497)	Controller Adaptation Inner Limits Reached (Low Reductant Delivery)

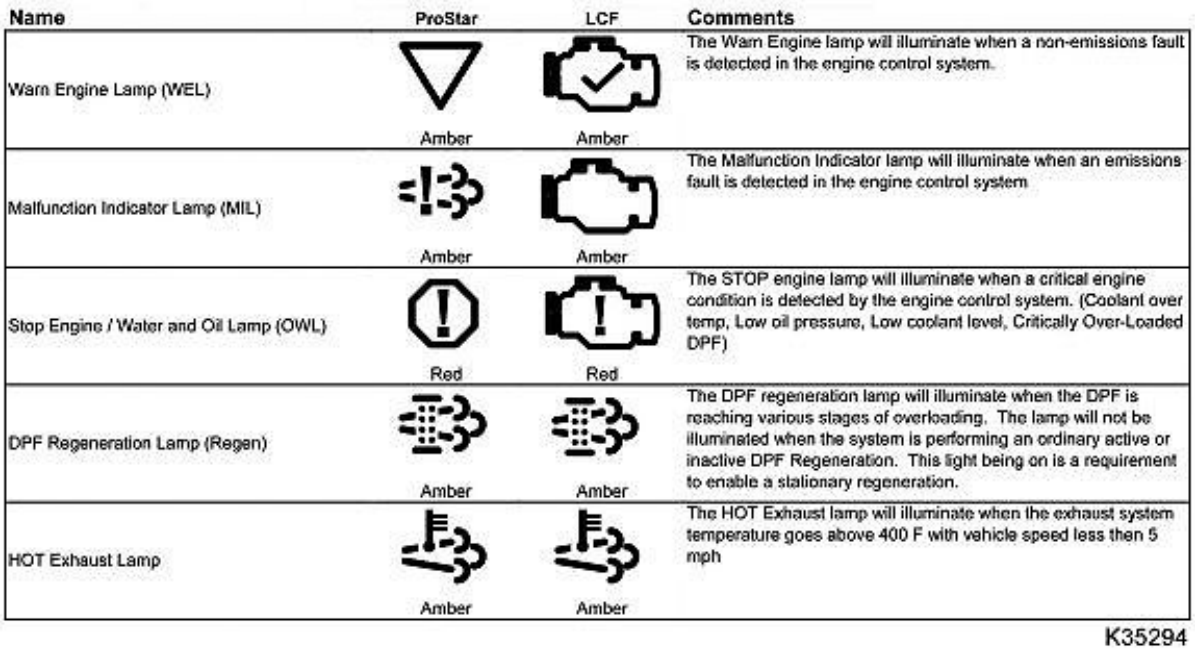


Figure 1 Warning Lamps

Operational Checkout Procedures

1.0 - Preliminary Vehicle Operational Checkout Procedure

Step 1	Inspect fuel level, quality, and fuel system.	Decision
Perform Fuel Level Inspection (page 2352), Fuel System Inspection (page 2349), and Fuel Quality Inspection (page 2350). Are fuel level and quality to specification, and did fuel system pass inspection?		Yes: Go to Step 2.
		No: Repair fuel system fault. After repairs are Operational Checkout Procedures complete, retest for original problem.

Step 2	Inspect batteries, electrical system, and connections.	Decision
	Perform Batteries and Electrical System Inspection (page 2393). Are batteries, electrical system, and connections in good condition, tight, not corroded, and is battery voltage in specification?	Yes: Go to Step 3.
		No: Repair broken, loose, or corroded electrical system connections or components. Charge batteries to 12.6 volts. After repairs are complete, retest for original problem.

Step 3	Inspect air intake system for damage or restrictions.	Decision
	Inspect Charge Air Cooler (CAC), Engine Throttle Valve (ETV), Mass Air Flow (MAF) sensor, air filter, intake piping, clamps, and connections for damage or restrictions. Are air intake system components damaged or restricted?	Yes: Repair air intake system damage or restrictions. After repairs are complete, retest for original problem.
		No: Go to Step 4.

Step 4	Inspect exhaust system for damage or restrictions.	Decision
	Inspect Diesel Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), Selective Catalyst Reduction (SCR) catalyst, exhaust brake, and exhaust piping for damage or restrictions. Are exhaust system components damaged or restricted?	Yes: Repair exhaust system damage or restrictions. After repairs are complete, retest for original problem.
		No: Go to Step 5.

Step 5	Inspect engine oil level.	Decision
	Perform Engine Oil Level Inspection (page 2353). Is engine oil level to specification?	Yes: Go to Step 6.
		No: Correct engine oil level problem. After repairs are complete, retest for original problem.

Step 6	Inspect engine coolant level and quality.	Decision
	Perform Coolant Level Inspection (page 2355) and Coolant Quality Inspection (page 2356) procedures. Are coolant level and quality to specification?	Yes: Go to Step 7.
		No: Fill engine coolant to specification. If coolant is contaminated, go to Coolant Contamination (page 88). After repairs are complete, retest for original problem.

Step 7	Verify Engine Control Module (ECM) communicates with Electronic Service Tool (EST), obtain vehicle health report, and check for current Engine Control Module (ECM) calibration.	Decision
	A. Connect EST with ServiceMaxx software and log-in. B. Perform Obtain Vehicle Health Report (page 2107). Is EST communicating with the ECM, and is ECM calibration current?	Yes: Go to Step 8.
		No, ECM calibration not current: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for original problem.
		No, EST not communicating with ECM: Go to 11.0 ECM Loss of Communication (page 43).

Step 8	Review Repair Order (RO) and operator complaint.
Go to operational checkout procedure for specific symptom: • 2.0 Engine Does Not Start Operational Checkout Procedure (page 26) • 3.0 Engine Hard to Start Operational Checkout Procedure (page 30) • 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure (page 34) • 5.0 Engine Running, Engine Under Load Operational Checkout Procedure (page 36) • 6.0 Cooling System Operational Checkout Procedure (page 38) • 7.0 Engine Oil System Operational Checkout Procedure (page 39) • Go to 8.0 Fuel System Operational Checkout Procedure (page 40) • 9.0 Engine Compression Brake Operational Checkout Procedure (page 41) • 10.0 SCR Aftertreatment Operational Checkout Procedure (page 42)	

2.0 - Engine Does Not Start Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine no start conditions and avoid unnecessary repairs.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if injector buzz test will identify a failed injector.	Decision
	Perform Injector (Buzz) Test (page 2154). Is an audible buzz sound heard from each injector?	Yes: Go to Step 3.
		No: Do injector circuit diagnostics (SPN 651-656 FMI 4, 5; SPN 2797, 2798 FMI 3, 4; SPN 3659-3664 FMI 4, 5) for specific failed injector(s). If circuit diagnostics passes, replace failed injector(s).

Step 3	Check for no start related Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for: • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electric Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 108, 158, 628, 629, 1136, 1387 Engine Control Module (ECM) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 51, 3464, Engine Throttle Valve (ETV) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) faults • SPN 4287 Engine Compression Brake Pressure (ECBP) Does EST DTC list have any active fault codes listed above?		Yes: Go to Fault Code Diagnostics for no start related SPN. No: Go to Step 4.

Step 4	Record snapshot of no start related Key-On Engine-Off (KOEO) Data.	Decision
	Perform Record Snapshot of KOEO data (page 2113). Are battery voltage, FDP, ICP, and engine temperature sensor values within KOEO specifications?	Yes: Go to Step 5.
		No: Battery voltage out of specification: Repair battery, starting system, charging system, or ECM PWR circuit problem. After repairs are complete, retest for original problem.
		No: FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 120).
		No: ICP out of specification: Go to SPN 164 FMI 0 Fault Code Diagnostics (page 1287).
		No: One or more engine temperature sensors not within 20°F (7°C) of others after cold soak: Go to Fault Code Diagnostics (page 142)for sensor out of specification.

Step 5	Record snapshot of engine cranking data.	Decision
	Perform Engine Cranking Test (page 2172). Are Switch Battery (SWBAT), Engine Speed (rpm), ICP, IPR, FDP, and EGR within engine cranking specification (page 2403)?	Yes: Go to Step 6.
		No, SWBAT or Engine Speed (rpm) out of specification: Go to 2.1 Engine Cranks Slow or Does Not Crank (page 49).
		No,: ICP or IPR out of specification: Go to CPA High-Pressure Oil

		Pump (HPOP) Test (page 2227).
		No, FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 2273).
		No,: EGR out of specification: Go to SPN 2791 FMI 7 Fault Code Diagnostics (page 1095).

Step 6	Engine no start, cold ambient temperature.	Decision
	Attempt to start engine. Does engine fail to start, specifically during cold ambient temperatures?	Yes: Go to 2.2 Engine No Start, Cold Ambient Temperature (page 53).
		No: Go to Step 7.

Step 7	Engine at operating temperature, no re-start.	Decision
	A. Run engine to operating temperature. B. Attempt to start engine at operating temperature. Does engine fail to start, specifically after being run to operating temperature?	Yes: Go to 2.3 Engine at Operating Temperature, No Re-Start (page 54).
		No: Go to 2.4 Engine Never Starts (page 57).

3.0 - Engine Hard to Start Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine hard to start conditions and to avoid unnecessary repairs.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for hard to start related Diagnostic Trouble Codes (DTC).	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for: • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electric Fuel Pump (EFP) • SPN 164 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 108, 158, 628, 629, 1136, 1387 Engine Control Module (ECM) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) faults • SPN 4287 Engine Compression Brake Pressure (ECBP) Does EST DTC list have any of the fault codes listed above?	Yes: Go to Fault Code Diagnostics (page 142) for hard to start related SPN.
		No: Go to Step 3.

Step 3	Record snapshot of hard to start related Key-On Engine-Off (KOEO) data.	Decision
	Perform Record Snapshot of KOEO Data (page 2113). Are battery voltage, Fuel Delivery Pressure (FDP), Injection Control Pressure (ICP), and engine temperature sensor values within Key-On Engine-Off specifications?	Yes: Go to Step 4.
		No, battery voltage out of specification: Repair battery, starting system, charging system, or ECM PWR circuit problem. After repairs are complete, retest for original problem.
		No, FDP out of specification: Go to 8.1 - Low Fuel Delivery Pressure (page 120).
		No, ICP out of specification: Go to SPN 164 FMI 0 Fault Code Diagnostics (page 1287).
		No, one or more engine temperature sensors Not within 20°F (7°C) of others after cold soak: Go to Fault Code Diagnostics (page 142) for sensor out of specification.

Step 4	Record snapshot of engine cranking data.	Decision
Perform Engine Cranking Test (page 2172). Are Switch Battery (SWBAT), Engine Speed (rpm), ICP, IPR, FDP, EGR, Turbocharger 1 Turbine Outlet Pressure (TC1TOP), EBP, and DPFDP within Engine cranking specification?		Yes: Go to Step 5 (page 32).
		No: SWBAT or Engine Speed (rpm) out of specification: Go to 2.1 Engine Cranks Slow or Does Not Crank (page 49).
		No: ICP or IPR out of specification: Go to CPA

	High-Pressure Oil Pump (HPOP) Test (page 2227).
	No: FDP out of specification: Go to 8.1 Low Fuel Delivery Pressure (page 120).
	No: EGR out of specification: Go to SPN 2791 FMI 7 Fault Code Diagnostics (page 1095).
	No: TC1TOP, EBP, or DPFDP out of specification: Look for exhaust restrictions. Go To Diesel Particulate Filter (DPF) Inspection (page 2370), Diesel Oxidation Catalyst (DOC) Inspection (page 2373), Selective Catalytic Reduction (SCR) Inspection (Selective Catalyst Reduction (SCR) Inspection, page 2375), and Decomposition Tube Inspection (Decomposition Reactor Tube Inspection, page 2380).

Step 5	Determine if engine will not start specifically during cold ambient temperatures.	Decision
	Attempt to start engine. Is engine hard to start, specifically during cold ambient temperatures?	Yes: Go to 3.1 Engine Hard to Start, Cold Ambient Temperature (page 60).
		No: Go to Step 6 (page 32).

Step 6	Determine if engine is hard to re-start after being run to operating temperature	Decision
	A. Run engine to operating temperature. B. Attempt to re-start engine at operating temperature. Is engine hard to re-start specifically after being run to operating temperature?	Yes: Go to 3.2 Engine at Operating Temperature, Hard to Re-Start (page 62).
		No: Go to Step 7 (page 33).

Step 7	Determine if engine starts, and then stalls.	Decision
	Attempt to start engine. Does engine start and then stall?	Yes: Go to 3.3 Engine Starts, Then Stalls (page 64).
		No: Go to 2.4 Engine Never Starts (page 57).

4.0 - Engine Running, Engine Not Under Load Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine running problems while engine is not under a load.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for related Diagnostic Trouble Codes (DTCs).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for: • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electronic Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) • SPN 105 Intake Manifold Temperature (IMT) Does EST DTC list have any of the above listed SPN?	Yes: Go to Fault Code Diagnostics for appropriate SPN. No: Go to Step 3.

Step 3	Record snapshot of engine running data and determine if engine idles properly.	Decision
Perform Record Snapshot of Engine Running Data (page 2113) while symptom is occurring. A. Run engine at idle. B. Full throttle for 15 seconds. C. Idle for 30 seconds. D. Full throttle for 15 seconds. E. Idle for 30 seconds. F. Stop recording. Does engine idle rough or surge at idle?		Yes: Go to 4.1 Rough Idle (page 66). No: Go to Step 4.

Step 4	Determine if engine is able to reach rated speed.	Decision
A. Start engine. B. Increase engine rpm to rated speed, and return to idle. Is engine able to reach rated speed?		Yes: Go to Step 5. No: Go to 4.2 Engine Unable to Reach Rated Speed (No Load) (page 70).

Step 5	Determine if a popping noise is coming from engine air intake.	Decision
A. Start engine. B. Listen for popping noise from engine air intake. C. Increase engine rpm to rated speed and return to idle. Is popping noise heard from engine air intake?		Yes: Go to 4.3 Popping Noise from Intake (page 72). No: Review operator complaint.

5.0 - Engine Running, Engine Under Load Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot engine running problems while under a load.

Step 1	Perform preliminary operational checkout procedure.	Decision
	Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?	Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for Diagnostic Trouble Codes (DTCs).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for: • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electronic Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651-656, 2797, 2798, 3055, 3659-3664, 4257 Injector (INJ) • SPN 105 Intake Manifold Temperature (IMT) Does EST DTC list have any of the above listed SPN?	Yes: Go to Fault Code Diagnostics for appropriate SPN (page 11). No: Go to Step 3.

Step 3	Record snapshot of engine running data and determine if engine has a misfire.	Decision
	Perform Record Snapshot of Engine Running Data (page 2231) while symptom is occurring. Does engine speed vary by 50 rpm or more while symptom is occurring?	Yes: Go to 5.2 Misfire (Stumble/Surge/Runs Rough) (page 80).
		No: Go to Step 4.

Step 4	Determine if engine has low power or slow acceleration.	Decision
	Review engine running snapshot. Does vehicle have low power or slow acceleration?	Yes: Go to 5.1 Low Power (Slow Acceleration) (page 74).
		No, if equipped with Power Takeoff (PTO): Go to Step 5.
		NOTE: No, if not equipped with PTO: review operator complaint.

Step 5	Determine if engine is able to reach desired speed during PTO operation.	Decision
	A. Start engine. B. Operate PTO. C. If vehicle is equipped with a manual PTO, increase engine rpm to desired operating speed. Does engine reach desired speed during PTO operation?	Yes: Review operator complaint.
		No: Go to 5.3 Engine Unable to Reach Desired Speed During PTO Operation (page 84).

6.0 - Cooling System Operational Checkout Procedure

CONTENT
UNDER
DEVELOPMENT

0000305681

7.0 - Lube Oil System Operational Checkout Procedure

CONTENT
UNDER
DEVELOPMENT

0000305681

8.0 - Fuel System Operational Checkout Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you Perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23)?		Yes: Go to Step 2.
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if engine has a fuel delivery problem.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel pressure between 60 and 100 psi?		Yes: Go to Step 3.
		No: Go to 8.1 Fuel Delivery Pressure (page 120).

Step 3	Determine if engine has fuel in the engine oil.	Decision
Look for engine oil over full ¾ “ or more and smells like fuel. Is fuel in the engine oil?		Yes: Go to Fuel in Engine Oil (page 124).
		No: Review operator complaint.

9.0 - Engine Compression Brake Operational Checkout Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Check for related Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: • SPN 191 Transmission Output Shaft Speed (TOSS) Vehicle Speed Sensor (VSS) • SPN 597 Engine Compression Brake Switch • SPN 4287 Engine Compression Brake Pressure (ECBP) Does EST DTC list have any of the above listed SPN?		Yes: Go to Fault Code Diagnostics for appropriate SPN.
		No: Perform 0 to 60 MPH Test (page 2236) while symptom is occuring, activate engine brake and deactivate engine brake. Go to Step 3

Step 3	Determine if engine compression brake is operating, or is engaged when not commanded On.	Decision
Review 0 to 60 snapshot Does engine brake activate and deactivate properly when commanded?		No, engine brake does not activate: Go to 9.1 Engine Compression Brake Inoperative (page 126).
		No, engine brake does not disengage when commanded Off: Go to 9.2 Engine Compression Brake Engaged When Not Commanded (page 129).
		Yes: Review operator complaint

10.0 - SCR Aftertreatment Operational Checkout Procedure

Overview

The following steps direct technicians to systematically troubleshoot Selective Catalyst Reduction (SCR) exhaust aftertreatment system problems and avoid unnecessary repairs.

CAUTION: The following service information **ONLY** applies to N9 and N10 engines with SCR aftertreatment systems. Using these diagnostics for any other engine or aftertreatment system will result in misdiagnosis and unnecessary repairs.

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2 (page 42).
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if parked regeneration will not activate.	Decision
Press Parked Regen Switch. Does exhaust aftertreatment regeneration start?		Yes: Press brake pedal to abort Parked Regen. Go to Step 3 (page 42).
		No: Go to 10.1 Parked Regen Will Not Activate (page 131).

Step 3	Determine if excessive black smoke comes out of exhaust.	Decision
Does excessive black smoke come out of exhaust?		Yes: Go to 10.2 Black Smoke (page 133).
		No: Go to Step 4 (page 42)

Step 4	Determine if excessive white smoke comes out of exhaust.	Decision
Does excessive white smoke come out of exhaust?		Yes: Go to 10.3 White Smoke (page 138).
		No: Review operator complaint.

11.0 - ECM Loss of Communication

Overview

Diagnose Engine Control Module (ECM) will not communicate with Electronic Service Tool (EST).

Possible Causes

- Theft Deterrent System
- Public CAN Circuit (terminating resistor, etc.)
- Any failed module on Public CAN
- Power and ground circuits to Diagnostic Connector
- Engine Control Module (ECM) power circuit (ECM fuse, ECM PWR Relay, etc.)
- ECM ground circuit
- Low Battery Voltage
- Faulty ECM

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 1.0 Preliminary Vehicle Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23).

Step 2	Determine if Electronic Service Tool (EST) is working properly.	Decision
A. Key-On Engine-Off (KOEO) B. Connect EST with ServiceMaxx™ to a second vehicle and log in. Does EST communicate properly with second vehicle?		Yes: Go to Step 3
		No: Repair EST. After repairs are complete, retest for original problem.

Step 3	Determine if EST communicates with other modules.	Decision
	A. Key-On Engine-Off (KOEO) B. Connect EST with ServiceMaxx™ to initial vehicle and log in. C. Under the Connection (Sniffer) tab verify equipped modules are listed under Module Name and Count is actively changing. Does EST communicate with modules other than the Engine Control Module (ECM)?	Yes: Go to Step 4 No: Go to Step 15

CAUTION: Always use the latest version of *N9 and N10 Engine and Aftertreatment Wiring Schematic* Form 0000003481. Failure to comply will cause misdiagnosis and unnecessary repairs.

Step 4	Determine if Engine Control Module (ECM) ground circuits are working properly.	Decision
	A. Key Off B. Connect Breakout Harness 00-00959-01 to ECM 76-pin gray chassis connector and ECM. C. Connect Breakout Harness 00-00959-01 to 180-pin Breakout Box 00-00956-08. D. Key-On Engine-Off (KOEO) E. Measure voltage between battery positive and pins C-2, 4, and 6. Are ECM ground circuits between pins C-2, 4, 6 and battery positive within 0.5V of battery voltage?	Yes: Go to Step 5 No: Repair ground circuits. After repairs are complete, retest for original problem.

Step 5	Determine if ECM is receiving ignition switch power.	Decision
	A. Key-On Engine-Off (KOEO) B. Measure SWBAT circuit voltage between battery ground and pin C-31. Is voltage between pin C-31 and battery negative within 0.5V of battery voltage?	Yes: Go to Step 7 No: Go to Step 6

Step 6	Determine if vehicle has an anti-theft system installed.	Decision
Look for anti-theft password switch panel on vehicle center panel. Does vehicle have an anti-theft system installed?		Yes: See *Electrical System troubleshooting Guide for Anti-Theft System* checks. After repairs are complete, retest for original problem.
		No: Repair SWBAT ignition switch circuit. After repairs are complete, retest for original problem.

Step 7	Determine if ECM MPR ground circuit is operating properly.	Decision
A. Key-On Engine-Off (KOEO) B. Remove ECM PWR Relay C. Measure voltage between battery positive and ECM PWR relay pin-85 Is voltage between pin 85 and battery positive within 0.5V of battery voltage?		Yes: Go to Step 10
		No: Go to Step 8

Step 8	Determine if ECM MPR ground circuit is open	Decision
A. Key-On Engine-Off (KOEO) B. Measure voltage between battery positive and pin C-70 Is voltage between pin C-70 and battery positive within 0.5V of battery voltage?		Yes: Go to Step 10
		No: Go to Step 9

Step 9	Determine if Engine Control Module (ECM) is operating properly.	Decision
A. Install a known good test ECM B. Attempt to recreate original problem Does original problem occur with test ECM?		Yes: Install original ECM. Verify each step was completed correctly and the proper decision was made.
		No: Replace ECM. After repairs are complete, retest for original problem.

Step 10	Determine if power circuits to the ECM are working properly.	Decision
A. Key-On Engine-Off (KOEO) B. Measure voltage between battery ground and pins C-1, 3 and 5 Are power circuits between pins C-1, 3 and 5 and battery ground within 0.5V of battery voltage?		Yes: Go to Step 11
		No: Diagnose and repair ECM power circuit (40A fuse, ECM PWR Relay, etc.). After repairs are complete, retest for original problem.

Step 11	Determine if Public CAN circuits between ECM and Diagnostic Connector are Open or have high resistance.	Decision
A. Key Off B. Disconnect Batteries C. Measure resistance between 9-pin Diagnostic Connector pin-D and ECM pin C-62 (CAN-L) D. Measure resistance between Diagnostic Connector pin-C and ECM pin C-61 (CAN-H) Are measured resistances 5 ohms or less?		Yes: Go to Step 12
		No: Repair open or high resistance in Public CAN circuit(s). After repairs are complete, retest for original problem.

Step 12	Measure resistance between Public CAN circuits.	Decision
Measure resistance between Diagnostic Connector pin-C and pin-D. Is resistance between Diagnostic Connector pin-C and pin-D approximately 60 ohms?		Yes: Go to Step 14
		No: Go to Step 13

Step 13	Measure terminating resistors.	Decision
A. Remove both 120 ohm Public CAN terminating resistors B. Measure resistance of each terminating resistor Is resistance of each terminating resistor approximately 120 ohms?		Yes: Repair Public CAN circuit wiring. After repairs are complete, retest for original problem.
		No: Replace defective terminating resistor(s). After repairs are complete, retest for original problem.

Step 14	Determine if Public CAN J1939 data link is operating properly.	Decision
A. Connect vehicle batteries B. Key-On Engine-Off (KOEO) C. Measure voltage between 9-pin Diagnostic Connector pin-C (CAN-H) and ground. Record measurement D. Measure voltage between Diagnostic Connector pin-D (CAN-L) and ground. Record measurement **NOTE:** The sum of CAN-H and CAN-L voltage measurements should add up to approximately 5V, and CAN-H voltage should be greater than CAN-L. Is the sum of CAN-H and CAN-L voltage measurements approximately 5V, and is CAN-H 2.7V (+-0.5V) and CAN-L is 2.3V (+-0.5V)?		Yes: Go to Step 9
		No: Repair Public CAN circuit wiring. After repairs are complete, retest for original problem.

Step 15	Determine if Diagnostic Connector has proper voltage and ground.	Decision
A. Measure voltage between 9-pin Diagnostic Connector pin-B and battery negative B. Measure voltage between Diagnostic Connector pin-A and battery positive Is power circuit between pin-B and battery ground within 0.5V of battery voltage; and is voltage between ground circuit pin-A and battery positive within 0.5V of battery voltage?		Yes: Go to Step 16
		No: Repair power and/or ground circuit(s) to the Diagnostic Connector. After repairs are complete, retest for original problem.

Step 16	Determine if Public CAN J1939 data link is operating properly.	Decision
	A. Key-On Engine-Off (KOEO) B. Measure voltage between 9-pin Diagnostic Connector pin-C (CAN-H) and ground. Record measurement C. Measure voltage between Diagnostic Connector pin-D (CAN-L) and ground. Record measurement **NOTE:** The sum of CAN-H and CAN-L voltage measurements should add up to approximately 5V, and CAN-H should be greater than CAN-L. Is the sum of CAN-H and CAN-L voltage measurements approximately 5V, and is CAN-H 2.7V (+-0.5V) and CAN-L is 2.3V (+-0.5V)?	Yes: Go to Step 17 No: repair Public CAN circuit wiring. After repairs are complete, retest for original problem.

Step 17	Determine what module is causing communication failure.	Decision
	Unplug one Public CAN module at a time, and check when EST CAN communication returns. Verify only one module is unplugged at any time. Does EST CAN communication return when a specific module is unplugged?	Yes: Replace faulty module with a known good module. After repairs are complete, retest for original problem. No: End Diagnostic Steps

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify Supervisor for further action.

Engine Does Not Start Symptoms

2.1 - Engine Cranks Fast, Slow, or Does Not Crank

Overview

Determine reason engine cranks too fast, too slow, or will not crank fast enough to start the engine.

Possible Causes

- Failed batteries or low charge
- Corroded or loose battery cables
- Master battery switch turned Off, or Open battery cable circuit
- Starting system faults
- Crank inhibit fault
- Charging system faults
- Internal engine damage (hydro lock due to Exhaust Gas Recirculation (EGR) cooler or injector tip failure, etc.)
- Starter or flywheel gear binding or not engaging properly
- Power Take Off (PTO) or engine drive engaged

NOTE: See appropriate Truck Electrical System Troubleshooting Guide for additional starting and charging system information.

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 2.0 Engine Does Not Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 2.0 Engine Does Not Start Operational Checkout Procedure (page 26).

WARNING: To prevent personal injury or death when working with batteries, always wear face or eye protection, have water supply available, ensure good ventilation, and be sure no flames or sparks are present.

Step 2	Determine if each vehicle battery is fully charged.	Decision
Measure batteries voltage with a Digital Multimeter (DMM). Is voltage of each battery 12.5 volts or more?		Yes: Go to Step 3 (page 50).
		No: Charge batteries. Test charging system. After repairs are complete, retest for original problem.

Step 3	Determine if engine cranks too fast.	Decision
Crank engine while observing engine rpm. Does engine crank too fast?		Yes: Go to Step 4 (page 50). No: Go to Step 5 (page 50).

Step 4	Determine if internal engine damage is present.	Decision
Perform KOEO Relative Compression Test (page 2167). Does one of more cylinders have significant speed difference(s) than others?		Yes: Repair engine damage. After repairs are complete, retest for original problem. No: Go to Engine Never Starts (page 57).

Step 5	Determine if master battery switch is Off or battery cable circuit has high resistance.	Decision
Turn ignition key to the Run position and observe instrument panel lights and listen for injector pre-cycle. Do instrument panel lights come on and did injectors pre-cycle?		Yes: Go to Step 6. No: Turn master battery switch On or fix battery cable circuit. After repairs are complete, retest for original problem.

CAUTION: Follow instructions and safety procedures suggested by test equipment manufacturers.

NOTE: Cold batteries deliver less current.

Step 6	Determine if batteries are able to deliver appropriate current to start engine.	Decision
Using Midtronics – inTELLECT EXP HD – Battery and Electrical System tester (EXP1000HD), test fully charged batteries. Follow directions in tester instruction manual. Do batteries pass test?		Yes: Go to Step 7. No: Slow charge or replace each battery that fails test. After repairs are complete, retest for original problem.

Step 7	Determine if PTO or engine drive is engaged.	Decision
Are PTO or engine drive engaged?		Yes: Disengage PTO accessories and engine drives. After repairs are complete, retest for original problem. No: Go to Step 8.

Step 8	Determine if engine has internal damage or starter / flywheel gears are binding.	Decision
Using Engine Rotation Tool ZTSE6072, rotate crankshaft by hand to determine if starter/flywheel gears are binding or engine has internal damage. Does crankshaft rotate appropriately?		Yes: Go to Step 9.
		No: Repair starter/flywheel binding or internal engine damage. See *Engine Service Manual*.

Step 9	Determine if starting system is operating properly.	Decision
Using Midtronics – inTELLECT EXP HD – Battery and Electrical System Tester (EXP1000HD), test starting system. Follow directions in tester instruction manual. Does starting system pass the test?		Yes: End Diagnostic Steps
		No, low current draw: Perform voltage drop test on main positive and negative battery cables. If voltage drop is 0.5 volts or more, clean or replace cable. After repairs are complete, retest for original problem.
		No, zero current draw: Check for crank inhibit faults, starter solenoid or circuit faults, failed starter, and ignition switch. After repairs are complete, retest for original problem.
		No, high current draw: Check for faulty starter or internal engine damage. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

2.2 - Engine No Start, Cold Ambient Temperature

Overview

Diagnose engine no start in cold ambient conditions (40°F {4°C} or colder).

Possible Causes

- Engine Coolant Temperature 1 (ECT1) sensor or circuit fault
- Engine Oil Temperature (EOT) sensor or circuit fault
- Low cylinder compression
- Failed intake air grid heater
- Open or shorted IAH grid heater wiring (high current)
- Failed Intake Air Heater Relay
- Intake Air Heater Control (IAHC) circuit fault (relay control)
- Open or shorted IAH relay wiring (high current)
- Failed engine coolant heater
- Failed oil pan heater

Test Procedure

Step 1	Perform operational checkout procedure	Decision
Did you perform 2.0 Engine Does Not Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 2.0 Engine Does Not Start Operational Checkout Procedure (page 26).

Step 2	Check for Intake Air Heater Control (IAHC) Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for SPN 729 Intake Air Heater Control (IAHC) (page 1272) fault codes. Is SPN 729 active?		Yes: Go to Fault Code Diagnostics for SPN 729.
		No: Go to Step 3.

Step 3	Test Intake Air Heater (IAH) system.	Decision
Perform Intake Air Heater System Tests (page 2283). Is IAH system operating properly and did all Intake Air Heater Tests pass?		Yes: Go to Step 4.
		No: Repair IAH faults. After repairs are complete, retest for original problem.

Step 4	Test coolant heater assembly.	Decision
Perform Coolant Heater Assembly Test (page 2307). Is engine coolant heater operating properly and did all tests pass?		Yes: Go to Step 5.
		No: Repair engine coolant heater assembly faults. After repairs are complete, retest for original problem.

Step 5	Test oil pan heater assembly.	Decision
Perform Oil Pan Heater Assembly Test (page 2309). Is oil pan heater operating properly and did all tests pass?		Yes: Perform Relative Compression Test (page 2167). If one or more cylinders have significant speed difference(s) than others, repair engine mechanical problem. After repairs are complete, retest for original problem.
		No: Repair oil pan heater assembly faults. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

2.3 - Engine at Operating Temperature, No Re-Start

Overview

Engine will not re-start, after being run to operating temperature.

Possible Causes

- Injection Control Pressure (ICP) leak
- ICP circuit fault
- Combustion leak to low-pressure fuel system (injector)

Test Procedure

Step 1	Perform operational Checkout procedure.	Decision
Did you perform 2.0 Engine Does Not Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 2.0 Engine Does Not Start Operational Checkout Procedure (page 26).

Step 2	Start and run engine to operating temperature.	Decision
Is Engine Coolant Temperature 1 (ECT1) 158°F (70°C) or more?		Yes: Go to Step 3.
		No: Run engine to operating temperature.

Step 3	With engine at operating temperature, check Injection– Control Pressure (ICP) at Key-On Engine-Off (KOEO).	Decision
A. Do not crank or run engine for 3 minutes or more, to allow ICP to bleed off. B. Using Electronic Service Tool (EST) with ServiceMaxx™ software, check ICP at KOEO. Is ICP above KOEO specification?		Yes: Go to SPN 164 FMI 0 SPN 164 FMI 0 (page 1287) Fault Code Diagnostics.
		No: Go to Step 4.

Step 4	With engine at operating temperature, record snapshot of engine cranking data.	Decision
Perform Engine Cranking Test (page 2172). Are ICP and Injection Pressure Regulator (IPR) within cranking specification?		Yes: Go to Step 5.
		No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 5	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Do one or more cylinders have significant speed difference(s) than others?		Yes: Repair engine mechanical problem. After repairs are complete, retest for original problem.
		No: Go to Step 6.

Step 6	Measure fuel pressure to determine if combustion pressure is leaking into the fuel system.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel pressure greater than specification and/or erratic?		Yes: Remove each injector and inspect injector seals and bottom of injector for burning. After repairs are complete, retest for original problem.
		No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

2.4 - Engine Never Starts

Overview

Determine reason engine cranks but will not start.

Possible Causes

- Engine Control Module (ECM) fault
- No Start related Diagnostic Trouble Codes (DTC)
- Air intake restriction
- Exhaust restriction
- Low Injection Control Pressure (ICP) or ICP leaks
- Injection Pressure Regulator (IPR) fault
- Low Fuel Delivery Pressure (FDP)
- Engine compression loss or mechanical problems
- Exhaust Gas Recirculation (EGR) system fault
- Combustion into fuel system

Test Procedure

Step 1	Perform operational checkout procedure	Decision
Did you perform 2.0 Engine Does Not Start Operational Checkout Procedure?		Yes: Go to Step 2 .
		No: Go to 2.0 Engine Does Not Start Operational Checkout Procedure (page 26).

Step 2	Determine if engine air intake is restricted.	Decision
A. Key-On Engine-Off (KOEO) B. Connect Electronic Service Tool (EST) with ServiceMaxx™ software to vehicle diagnostic connector. C. Select > Sessions > Default > Pressure D. Observe (KOEO) Intake Manifold Absolute Pressure (IMAP) E. Observe IMAP while cranking the engine F. Calculate intake restriction: KOEO IMAP – Cranking IMAP = intake restriction while cranking Is intake restriction 0.9 psi (6 kPa) or greater?		Yes: Repair intake restriction. After repairs are complete, retest for original problem. No: Go to Step 3.

Step 3	Determine if exhaust is restricted.	Decision
Review Engine Cranking Test (page 2172) data. Are Turbocharger 1 Turbine Outlet Pressure (TC1TOP), Exhaust Back Pressure (EBP), and Diesel Particulate Filter Differential Pressure (DPFDP) within cranking specification?		Yes: Go to Step 4. No: Repair exhaust restriction. After repairs are complete, retest for original problem.

Step 4	Determine if engine is able to build Injection Control Pressure (ICP).	Decision
Review Engine Cranking Test (page 2172) data. Are ICP and Injection Pressure Regulator (IPR) both in specification?		Yes: Go to Step 5. No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 5	Determine if engine is able to build Fuel Delivery Pressure (FDP).	Decision
Record snapshot of KOEO Data (page 2113) and review Engine Cranking Test (page 2172). Is FDP in specification during KOEO and cranking tests?		Yes: Go to Step 6. No: Go to 8.1 Fuel Delivery Pressure (page 120).

Step 6	Determine if cylinder relative compression is within specification.	Decision
Perform KOEO Relative Compression Test. (page 2167) Do one or more cylinders have significant speed difference(s) than others?		Yes: Repair engine mechanical problem. After repairs are complete, retest for original problem.
		No: Go to Step 7.

Step 7	Measure fuel pressure to determine if combustion pressure is leaking into the fuel system.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel pressure greater then specification and/or erratic?		Yes: Inspect injector seals and bottom of each injector for burning. After repairs are complete, retest for original problem.
		No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Engine Hard to Start Symptoms

3.1 - Engine Hard to Start, Cold Ambient Temperature

Overview

Diagnose engine hard to start in cold ambient conditions (40°F {4°C} or colder).

Possible Causes

- Engine Coolant Temperature 1 (ECT1) sensor or circuit fault
- Engine Oil Temperature (EOT) sensor or circuit fault
- Low cylinder compression
- Failed intake air grid heater
- Open or shorted Intake Air Heater (IAH) grid heater wiring (high current)
- Failed intake air heater relay
- Intake Air Heater Control (IAHC) circuit fault (relay control)
- Open or shorted IAH relay wiring (high current)
- Failed engine coolant heater
- Failed oil pan heater

Test Procedure

Step 1	Perform operational checkout procedure	Decision
Did you perform 3.0 Engine Hard to Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 3.0 Engine Hard to Start Operational Checkout Procedure (page 30).

Step 2	Check for Intake Air Heater Control (IAHC) Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for SPN 729 IAHC fault codes (page 1272). Is SPN 729 active?		Yes: Go to Fault Code Diagnostics for SPN 729 (page 1272).
		No: Go to Step 3.

Step 3	Test Intake Air Heater (IAH) system.	Decision
Perform Intake Air Heater Tests (page 2283). Is IAH system operating properly and did all Intake Air Heater Tests pass?		Yes: Go to Step 4.
		No: Repair IAH faults. After repairs are complete, retest for original problem.

Step 4	Test engine coolant heater assembly.	Decision
Perform Coolant Heater Assembly Test (page 2307). Is engine coolant heater operating properly and did all tests pass?		Yes: Go to Step 5.
		No: Repair engine coolant heater assembly faults. After repairs are complete, retest for original problem.

Step 5	Test oil pan heater assembly.	Decision
Perform Oil Pan Heater Assembly Test (page 2309). Is oil pan heater operating properly and did all tests pass?		Yes: Perform Relative Compression Test (page 2167). If one or more cylinders have significant speed difference(s) than others, repair engine mechanical problem. After repairs are complete, retest for original problem.
		No: Repair oil pan heater assembly faults. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

3.2 - Engine at Operating Temperature, Hard to Re-Start

Overview

Diagnose engine hard to re-start after being run up to operating temperature.

Possible Causes

- Injection Control Pressure (ICP) leak
- ICP circuit fault
- Combustion leak to low-pressure fuel system (injector)

Test Procedure

Step 1	Perform operational checkout procedure	Decision
Did you perform 3.0 Engine Hard to Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 3.0 Engine Hard to Start Operational Checkout Procedure (page 30).

Step 2	Start and run engine to operating temperature.	Decision
Is Engine Coolant Temperature 1 (ECT1) 158°F (70°C) or more?		Yes: Go to Step 3.
		No: Run engine to operating temperature, then go to Step 3.

Step 3	With engine at operating temperature, check Key-On Engine-Off (KOEO) Injection Control Pressure (ICP).	Decision
A. Do not crank or run engine for 3 minutes or more, to allow Injection Control Pressure (ICP) to bleed off. B. Using Electronic Service Tool (EST) with ServiceMaxx™ software, check ICP at KOEO. Is ICP above KOEO specification?		Yes: Go to SPN 164 FMI 0.
		No: Go to Step 4.

Step 4	With engine at operating temperature, perform Engine Cranking Test (page 2172).	Decision
Are ICP and Injection Pressure Regulator (IPR) within cranking specification?		Yes: Go to Step 5.
		No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 5	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167).		Yes: Repair engine mechanical problem. After repairs are complete, retest for original problem.
		No: Go to Step 6.

Step 6	Measure fuel pressure to determine if combustion pressure is leaking into the fuel system.	Decision
Perform Fuel Delivery Pressure (FDP) test (page 2273). Is fuel pressure greater than specification and/or erratic?		Yes: Remove each injector and inspect injector seals and bottom of injector for burning. After repairs are complete, retest for original problem.
		No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

3.3 - Engine Starts, Then Stalls

Overview

Engine is able to start (possibly briefly), but is not able to continue to run.

Possible Causes

- Damaged or restricted intake: Change Air Cooler (CAC), Engine Throttle Valve (ETV), Mass Air Flow (MAF), air filter, intake piping, clamps, connections, etc.
- Damaged or restricted exhaust: Diesel Oxidation Catalyst (DOC), Diesel Particulate Filter (DPF), Selective Catalytic Reduction (SCR) catalyst, exhaust brake, exhaust piping, etc.
- Exhaust Gas Recirculation (EGR) valve (stuck or sticking open)
- Combustion gasses in fuel (injector)

Test Procedure

Step 1	Perform operational checkout procedure	Decision
Did you perform 3.0 Engine Hard to Start Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 3.0 Engine Hard to Start Operational Checkout Procedure (page 30).

Step 2	Determine if engine air intake is restricted.	Decision
A. Key-On Engine-Off (KOEO) B. Connect Electronic Service Tool (EST) with ServiceMaxx™ software. C. Select > Sessions > Default > Pressure. D. Observe KOEO Intake Manifold Absolute Pressure (IMAP) E. Observe IMAP, while cranking the engine. F. Calculate intake restriction: KOEO IMAP – Cranking IMAP = intake restriction while cranking G. Is intake restriction 0.9 psi or greater?		Yes: Repair intake restriction. After repairs are complete, retest for original problem.
		No: Go to Step 3.

Step 3	Determine if Exhaust Gas Recirculation (EGR) valve is stuck or sticking open.	Decision
Perform EGRV Operational Test (page 2271). Does EGR system pass EGRV Operational Test?		Yes: Go to Step 4. No: Repair EGR system problem. After repairs are complete, retest for original problem.

Step 4	Determine if cylinder relative compression is within specifications.	Decision
Perform Relative Compression Test (page 2167). Do one or more cylinders have significant speed difference(s) than others?		Yes: Repair engine mechanical problem. After repairs are complete, retest for original problem. No: Go to Step 5.

Step 5	Measure fuel pressure to determine if combustion pressure is leaking into the fuel system.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel pressure greater then specification and / or erratic?		Yes: Inspect injector seals and bottom of each injector for burning. After repairs are complete, retest for original problem. No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Engine Running, Engine Not Under Load Symptoms

4.1 - Rough Idle

Overview

Diagnose cause of engine runs rough or surges at idle.

CAUTION: It is normal for engine to idle rough until engine coolant temperature reaches 141°F (61°C) or more. Failure to allow engine to warm up properly will cause misdiagnosis and unnecessary repairs.

Possible Causes

- Injection Control Pressure (ICP)
- Injection Pressure Regulator (IPR)
- Fuel Delivery Pressure (FDP) (low pressure, aerated fuel, etc.)
- Injector circuit or mechanical failure
- Engine compression loss in one or more cylinders
- Engine air intake leaks (unmetered air entering engine air intake)
- Engine accessory dragging or locking up (A/C compressor, belt tensioner, fan drive, etc.)

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure (page 34).

Step 2	Determine if Injection Pressure Regulator (IPR) system is operating properly.	Decision
Review engine running snapshot: verify IPR Ctrl is less than 35% at idle. Is IPR Ctrl 35% or greater at idle?		Yes: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).
		No: Go to Step 3.

Step 3	Determine if ICP system is operating properly.	Decision
Review snapshot: verify Injection Control Pressure (ICP) is approximately the same as ICP Desired. Is ICP approximately the same as ICP Desired?		Yes: Go to Step 4.
		No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 4	Determine if Injection Pressure Regulator (IPR) system is operating properly.	Decision
Review 0 to 60 snapshot: Verify IPR Ctrl is less than 80% Is IPR Ctrl 80% or greater?		Yes: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).
		No: Go to Step 5.

Step 5	Determine if injectors and injector circuits are operating properly.	Decision
Perform CPA Cold Idle Test (page 2201) and CPA Hot Idle Test (page 2212). Does CPA Cold Idle Test and/or CPA Hot Idle Test determine a fault?		Yes, injector fault: Check resistance of suspect injector circuit. Repair circuit problem(s). If circuit checks are good, replace injector. After repairs are complete, retest for original problem.
		Yes, high speed fluctuation: Check resistance in injector circuits through the UVC gasket. Repair circuit problem(s). If UVC checks are good go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).
		No: Go to Step 6.

Step 6	Determine if fuel delivery pressure is within specification.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel delivery pressure (gauge) within Low Idle, No Load, Stabilized Engine Operating Temperature (page 2403) specification?		Yes: Go to Step 7.
		No: Go to 8.1 Fuel Delivery Pressure (page 120).

CAUTION: To prevent engine damage, do not run engine more than 2 minutes with accessory drive belts disconnected.

Step 7	Determine if engine accessories are dragging or locking up.	Decision
A. Remove accessory drive belt(s). B. Start engine and check for accessories dragging or locking up. Is rough engine idle still present?		Yes: Go to Step 8.
		No: Find and repair accessory dragging or locking up. After repairs are complete, retest for original problem.

Step 8	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Does one or more cylinders have significant speed difference(s) than others?		Yes: Repair engine mechanical or injector seal problem. After repairs are complete, retest for original problem.
		No: Go to Step 9.

Step 9	Determine if engine has air intake leaks.	Decision
Inspect engine air intake piping, clamps, air filter and housing, screen under air filter, Charge Air Cooler (CAC), and Interstage Cooler (ISC) (if equipped) for leaks, damage, or restrictions. Is engine air intake leaking, damaged, or restricted?		Yes: Repair engine air intake as needed. After repairs are complete, retest for original problem.
		No: Connect Cylinder Performance Analyzer (CPA) Tool (page 2197) and test injectors for leaks and misfires. Perform CPA Signal Check (page 2206), CPA Hot Idle Test (page 2212), and CPA Road Test (page 2217).

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

4.2 - Engine Unable To Reach Rated Speed (No Load)

Overview

Engine without a load is not able to increase rpm up to rated speed.

Possible Causes

- Accelerator Pedal Position (APP)
- Injection Control Pressure (ICP)
- Injection Pressure Regulator (IPR)
- Exhaust Gas Recirculation (EGR)
- Exhaust restriction
- Engine air restriction
- Fuel Delivery Pressure (FDP)

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure (page 34).

Step 2	Determine if Accelerator Pedal Position (APP) meets full range %.	Decision
Review engine running snapshot. Verify APP percentage at idle and at full throttle. Is APP 0% at idle and 99% or greater at full throttle?		Yes: Go to Step 3.
		No: Repair APP sensor or circuit problem. After repairs are complete, retest for original problem.

Step 3	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
Review engine running snapshot. Verify Injection Control Pressure is approximately the same as ICP Desired. Is Injection Control Pressure approximately the same as ICP Desired?		Yes: Go to Step 4.
		No: Go to CPA – High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 4	Determine if Exhaust Gas Reticulation (EGR) system is operating properly.	Decision
Review engine running snapshot. Verify EGR valve remains closed (35%). Is EGR Position 35%?		Yes: Go to Step 5.
		No: Go to SPN 2791 FMI 7 (page 1095) Fault Code Diagnostics. After repairs are complete, retest for original problem.

Step 5	Determine if exhaust system is restricted.	Decision
Review engine running snapshot. Verify Turbocharger 1 Turbine Outlet Pressure (TC1TOP) is less than 10 psi. Is TC1TOP 10 psi or greater?		Yes: Repair exhaust system restriction. After repairs are complete, retest for original problem.
		No: Go to Step 6.

Step 6	Determine if air intake is restricted.	Decision
Review engine running snapshot. Verify Intake Manifold Absolute Pressure is above BARO (not creating a vacuum). Is Intake Manifold Absolute Pressure above BARO?		Yes: Go to Step 7.
		No: Repair intake restriction. After repairs are complete, retest for original problem.

Step 7	Determine if fuel delivery pressure is within specification.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Does fuel delivery pressure (gauge) meet specification?		Yes: Connect CPA Tool (page 2197)and perform CPA Signal Check (page 2206), CPA Hot Idle Test (page 2212), and CPA Road Test (page 2217).
		No: Go to 8.1 Fuel Delivery Pressure (page 120).

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

4.3 - Popping Noise from Intake

Overview

Engine cylinder compression popping back through the intake.

Possible Causes

- Contaminated or incorrect fuel
- Sticking, damaged, or leaking intake or exhaust valve(s)
- Damaged pushrod(s)
- Damaged rocker arm or shaft
- Failed roller tappet assembly
- Failed camshaft

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure?		Yes: Go to Step 2.
		No: Go to 4.0 Engine Running, Engine Not Under Load Operational Checkout Procedure (page 34).

Step 2	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Does one or more cylinders have significant speed difference(s) than others?		Yes: Focus on cylinder(s) with low compression, and go to Step 3.
		No: Go to Step 3.

Step 3	Inspect valve train for loose or damaged rocker arm assembly, or valve lash out of adjustment.	Decision
A. Remove valve cover. See *Engine Service Manual* . B. Inspect valve train for loose or damaged rocker arms, or valve lash out of adjustment (focusing on any cylinders with low compression from Step 1). C. Measure valve lash. Is valve train for any cylinders loose, damaged, or valve lash out of adjustment?		Yes, damaged rocker arm assembly: Replace damaged valve train components. After repairs are complete, retest for original problem.
		Yes, valve lash out of adjustment: Perform Cleaning and Inspection of Push rods, and Measure Camshaft Lobe Lift in the *Engine Service*

	Manual. If camshaft lobe lift is out of specification, replace camshaft.
	No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Engine Running, Engine Under Load Symptoms

5.1 - Low Power (Slow Acceleration)

Overview

Vehicle or engine is not able to accelerate properly while under a load.

Before beginning the following diagnostics, perform 1.0 – Preliminary Vehicle Operational Checkout Procedure (page 23), and 5.0 – Engine Running, Engine Under Load Operational Checkout Procedures (page 36).

Possible Causes

- Vehicle overloaded (load higher then engine designed for)
- Road speed governor programmable parameter set too low
- Accelerator Pedal Position (APP) sensor or circuit
- Injection Control Pressure (ICP)
- Injection Pressure Regulator (IPR)
- Engine Control Module (ECM) barometric pressure error
- Exhaust restriction
- Boost control system fault
- Fuel Delivery Pressure (FDP)
- Exhaust Gas Recirculation (EGR) valve stuck or sticking open
- Intake restriction
- Turbocharger coking or damage
- Low compression
- Engine compression brake engaged when not commanded.

Test Procedure

Step 1	Determine if vehicle is overloaded.	Decision
Review vehicle and engine load hauling capacity and compare to Tcape summary (available from International dealer). Is vehicle overloaded?		Yes: Reduce load. After repairs are complete, retest for original problem.
		No: Go to Step 2.

Step 2	Verify Road Speed Governor programmable parameter is set above desired vehicle speed.	Decision
A. Connect Electronic Service Tool (EST) with ServiceMaxx™ software and log-in. B. Select > Sessions > Parameters > Max Vehicle Speed with Road Speed Limiting On, OR Road Speed Limiting Secondary Vehicle Speed Limit. Are Road Speed Limiting programmable parameters set above desired vehicle speed?		Yes: Go to Step 3. No: Set Road Speed Limiting programmable parameters to maximum desired vehicle speed. After repairs are complete, retest for original problem.

Step 3	Determine if Accelerator Pedal Position (APP) sensor is operating properly.	Decision
A. Key-On Engine-Off (KOEO). B. Connect EST with ServiceMaxx™ software and log in. C. Select Sessions > Performance D. Select Tools > Start Recording Snapshot E. Cycle accelerator pedal to full throttle and then release. F. Select Tools > Stop Recording Snapshot Is Accelerator Pedal Position 99% or greater at full throttle?		Yes: Perform 0 to 60 MPH Test (page 2240), and then go to Step 4. No: Repair or replace APP sensor or circuit. After repairs are complete, retest for original problem.

Step 4	Determine if engine compression brake is operating properly (if equipped).	Decision
Review 0 to 60 snapshot: verify BCP actual is approximately the same as BCP desired. Is BCP actual approximately the same as BCP desired, and when desired is 0, actual is below 100 psi?		Yes: Go to Step 5. No: Go to Engine Compression Brake Engaged when Not Commanded.

Step 5	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
Review 0 to 60 snapshot: verify Injection Control Pressure is approximately the same as ICP Desired. Is Injection Control Pressure approximately the same as ICP Desired and above 4000 psi at 100% APP and 100% Engine Load?		Yes: Go to Step 6. No: Go to Cylinder Performance Analyzer (CPA) High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 6	Determine if Injection Pressure Regulator (IPR) system is operating properly.	Decision
Review 0 to 60 snapshot: verify IPR Ctrl is less than 80%. Is IPR Ctrl 80% or greater?		Yes: Go to Cylinder Performance Analyzer (CPA) High-Pressure Oil Pump (HPOP) Test (page 2227). No: Go to Step 7.

Step 7	Verify Engine Control Module (ECM) is reading proper Barometric Absolute Pressure for local elevation and barometric pressure.	Decision
A. Review 0 to 60 snapshot: determine recorded Barometric Absolute Pressure. B. Determine local elevation and barometric pressure. (Examples: 14.7 psia at sea level, 13.2 psia at 3000 ft., 11.8 psia at 6000 ft., 10.1 psia at 10,000 ft.) C. If Barometric Absolute Pressure is not reasonable relative to local barometric pressure, verify local barometric pressure on a second vehicle. Is Barometric Absolute Pressure reasonable relative to local barometric pressure?		Yes: Go to Step 8. No: Install a test ECM and fault should go away. Install original ECM. If fault returns, replace ECM. After repairs are complete, retest for original problem.

Step 8	Determine if exhaust is restricted.	Decision
Review 0 to 60 snapshot: verify Turbocharger 1 Turbine Outlet Pressure (TC1TOP) is less than 20 psi. Is TC1TOP 20 psi or greater?		Yes: Repair exhaust system restriction. After repairs are complete, retest for original problem. No: Go to Step 9.

Step 9	Determine if boost control system is operating properly.	Decision
Review 0 to 60 snapshot: verify Exhaust Back Pressure (EBP) is less than 70 psi. Is EBP less than 70 psi?		Yes: Go to Step 10.
		No: Perform Boost Control System Test (page 2256). After repairs are complete, retest for original problem.

Step 10	Determine is Fuel Delivery Pressure (FDP) meets specification.	Decision
Review 0 to 60 snapshot: verify FDP is within Full Load specification. Is FDP within Full Load specification?		Yes: Go to Step 11.
		No: Go to 8.1 – Low Fuel Delivery Pressure (page 120).

Step 11	Determine if Exhaust Gas Recirculation (EGR) valve is operating properly.	Decision
Review 0 to 60 snapshot: verify EGR Position is approximately the same as EGR Valve CTL. Is EGR Position approximately the same as EGR Valve CTL?		Yes: Go to Step 12.
		No: Go to SPN 2791 FMI 7 (page 1095) in Fault Code Diagnostics. After repairs are complete, retest for original problem.

Step 12	Validate performance of EGR system.	Decision
Perform Air Management Test (page 2175). Does Air Management Test pass and no fault codes are set?		Yes: Go to step 13.
		No: Go to Fault Code Diagnostics (page 142) for specific SPN/FMI. After repairs are complete, retest for original problem.

Step 13	Determine if Intake Manifold Pressure (IMP) during acceleration is reasonable.	Decision
Review 0 to 60 snapshot: verify IMP is within 5 psi of Full Load specification for specific rating of engine. IMP can vary based on ECM calibration (engine rating) and vehicle weight. Is IMP within 5 psi of Full Load specification, for specific rating?		Yes: Go to Step 16.
		No: Go to Step 14.

Step 14	Inspect for intake (boost) leaks or restrictions.	Decision
A. Inspect air intake system from air filter to engine intake manifold for air leaks, damage, or restrictions. B. Pressurize the Charge Are Cooler (CAC) system to 35 psi using Charge Air Cooler (CAC)Tester ZTSE4341 and Interstage Cooler Test Kit ZTSE4937. C. Inspect hoses and clamps, interstage cooler, and Charge Air Cooler (CAC). Is the air intake system and CAC system free of restrictions, leaks, or physical damage?		Yes: Go to Step 14. No: Repair air intake system leaks, damage, or restrictions. After repairs are complete, retest for original problem.

Step 15	Determine if turbocharger has damage or coking.	Decision
Inspect turbocharger for damage or coking. Remove turbocharger intake tube. Inspect for coking. Rotate impeller shaft. Determine if impeller fins are contacting housing. Does turbocharger have damage or coking		Yes, turbocharger coking and no damage: Perform Dual Turbocharger Compressor Cleaning and Inspection in the *Engine Service Manual*. After repairs are complete, retest for original problem.
		Yes, turbocharger damaged: replace turbocharger (iApproval may be required). After repairs are complete, retest for original problem.
		Go to Step 16

Step 15	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Does one or more cylinders have significant speed difference(s) than others?		Yes: Repair engine mechanical, injector seal, or engine compression brake problems. After repairs are complete, retest for original problem.
		No: End Diagnostic Steps

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

5.2 - Misfire (Stumble / Surge / Runs Rough)

Overview

Engine power or speed (rpm) varies unexpectedly by more than 50 rpm under a load.

Possible Causes

- Accelerator Pedal Position (APP) sensor or circuit
- Exhaust Back Pressure Valve (EBPV)
- Engine Throttle Valve (ETV)
- Exhaust Gas Recirculation (EGR) valve stuck or sticking
- Injection Control Pressure (ICP) system
- Injection Pressure Regulator (IPR)
- Fuel Delivery Pressure (FDP)
- Air intake (boost) leaks
- Engine compression loss of one or more cylinders
- Injector circuit or mechanical problem

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 5.0 Engine Running, Engine Under Load Operational Checkout Procedure?		Yes: Go to Step 2. No: Go to 5.0 Engine Running, Engine Under Load Operational Checkout Procedure (page 36).

Step 2	Determine if Accelerator Pedal Position (APP) signal is correct and stable.	Decision
Review snapshot of engine running data: Verify APP signal moves smoothly as the throttle is depressed and does not jump unexpectedly. Is APP signal stable and not jumping unexpectedly, 0% at idle, and 99% or greater at full throttle?		Yes: Go to Step 3. No: Repair APP sensor or circuit problem. After repairs are complete, retest for original problem.

Step 3	Determine if Exhaust Back Pressure Valve (EBPV) is operating properly.	Decision
A. Start engine. B. Visually verify if EBPV is fully open and not moving (unless in regen mode). Look at valve and verify rod is fully retracted and not moving. C. Verify if EBPV cycles opened and closed three times after engine shutdown. Is EBPV fully open and not moving (unless in regen mode), and does EBPV cycle after shutdown?		Yes: Go to Step 4. No: Diagnose and repair EBPV system. After repairs are complete, retest for original problem.

Step 4	Determine if Engine Throttle Valve (ETV) is operating properly.	Decision
Review snapshot of engine running data: compare Engine Throttle Position (actual) to Engine Throttle CTL. Is Engine Throttle Position approximately the same as Engine Throttle CTL?		Yes: Go to Step 5. No: Repair ETV or circuit problem. After repairs are complete, retest for original problem.

Step 5	Determine if Exhaust Gas Recirculation (EGR) system is operating properly.	Decision
Review snapshot of engine running data: verify if EGR Position is approximately the same as EGR Valve CTL. Is EGR Position approximately the same as EGR Valve CTL?		Yes: Go to Step 6. No: Go to SPN 2791 FMI 7 (page 1095)Fault Code Diagnostics. After repairs are complete, retest for original problem.

Step 6	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
Review snapshot of engine running data: verify Injection Control Pressure is approximately the same as ICP Desired. Is Injection Control Pressure approximately the same as ICP Desired?		Yes: Go to Step 7. No: Go to CPA – High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 7	Determine if Injection Pressure Regulator (IPR) system is operating properly.	Decision
Review snapshot of engine running data: verify if IPR Ctrl is less than 80% while under load or less than 35% when stationary. Is IPR Ctrl 80% or greater under load, or greater than 35% when stationary?		Yes: Go to CPA – High-Pressure Oil Pump (HPOP) Test (page 2227). No: Go to Step 8.

Step 8	Determine if fuel delivery pressure is proper.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Is fuel delivery pressure (gauge) within specification ?		Yes: Go to Step 9. No: Go to 8.1 – Fuel Delivery Pressure (page 120).

Step 9	Inspect for air intake (boost) leaks or restrictions.	Decision
A. Inspect air intake system from air filter to engine intake manifold for air leaks, damage, or restrictions. B. Pressurize the Charge Are Cooler (CAC) system to 30 psi using Charge Air Cooler (CAC)Tester ZTSE4341 and Interstage Cooler Test Kit ZTSE4937. C. Inspect hoses and clamps, interstage cooler, and Charge Air Cooler (CAC). Is the air intake system and CAC system free of restrictions, leaks, or physical damage?		Yes: Go to Step 10. No: Repair air intake system leaks, damage, or restrictions. After repairs are complete, retest for original problem.

Step 10	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Does one or more cylinders have significant speed difference(s) than others?		Yes: Using *Engine Service Manual*, repair engine mechanical or injector problem. After repairs are complete, retest for original problem. No: Connect Cylinder Performance Analyzer (CPA) Tool (page 2197) and test injectors for leaks and misfires. Perform CPA Signal Check (page 2206), CPA Hot Idle Test (page 2212), and CPA Road Test (page 2217).

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

5.3 - Engine Unable to Reach Desired Speed During PTO Operation

Overview

Engine is not able to increase rpm up to desired speed during Power Take Off (PTO) operation.

Before beginning the following diagnostics perform 1.0 Preliminary Vehicle Operational Checkout Procedure (page 23) and 4.0 Engine Running, Engine Under Load Operational Checkout Procedure (page 34).

Possible Causes

- Power Take Off (PTO) circuit or system fault
- Auxiliary Engine Speed Control (AESC) set speed (not set high enough or not set correctly)
- Accelerator Pedal Position (APP)
- Injection Control Pressure (ICP)
- Injection Pressure Regulator (IPR)
- Exhaust Gas Recirculation (EGR)
- Exhaust restriction
- Intake restriction
- Fuel Delivery Pressure (FDP)

Test Procedure

NOTE: See *CT-471 Body Builder* books for additional Power Take Off (PTO) and Auxiliary Engine Speed Control (AESC) information.

Step 1	Determine if Power Take Off (PTO) engages.	Decision
Engage PTO (See *CT-471 Body Builder Manual*). Did PTO engage properly?		Yes: Go to Step 2.
		No: Diagnose and repair PTO problem. After repairs are complete, retest for original problem.

Step 2	Verify if Auxiliary Engine Speed Control (AESC) / remote engine throttle programmable parameters are set above desired speed.	Decision
A. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). B. Using ServiceMaxx™ software, select Sessions > Parameters. Are AESC parameters set above desired engine speed?		Yes: Go to Step 3.
		No: Set AESC programmable parameters to maximum desired engine speed. After repairs are complete, retest for original problem.

Step 3	Determine if Accelerator Pedal Position (APP) meets full range percent.	Decision
Review engine running snapshot. Verify percent at idle and full throttle. Is APP 0% at idle and 99% or greater at full throttle?		Yes: Go to Step 4.
		No: Repair APP sensor or circuit problem. After repairs are complete, retest for original problem.

Step 4	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
Review engine running snapshot. Verify if ICP is approximately the same as ICP Desired. Is ICP approximately the same as ICP Desired?		Yes: Go to Step 5.
		No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 5	Determine if Exhaust Gas Reticulation (EGR) system is operating properly.	Decision
Review engine running snapshot. Verify if EGR Position is approximately the same as EGR Valve CTL. Is EGR position approximately the same as EGR Valve CTL?		Yes: Go to Step 5. No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 6	Determine if exhaust system is restricted.	Decision
Review engine running snapshot. Verify if Turbocharger 1 Turbine Outlet Pressure (TC1TOP) is less than 20 psi. Is TC1TOP 20 psi or greater?		Yes: Repair exhaust system restriction. After repairs are complete, retest for original problem. No: Go to Step 7.

Step 7	Determine if air intake is restricted.	Decision
Review engine running snapshot. Verify if Intake Manifold Absolute Pressure is xxx? Is Intake Manifold Absolute Pressure xxx?		Yes: Go to Step 8. No: Repair intake restriction. After repairs are complete, retest for original problem.

Step 8	Determine is fuel delivery pressure meets specification.	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Does FDP (gauge) meet low idle, no load, stabilized engine operating temperature specification?		Yes: Perform CPA Signal Check (page 2206), CPA Hot Idle Test (page 2212), and CPA Road Test (page 2217). No: Go to 8.1 Low Fuel Delivery Pressure (page 120).

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Engine Coolant Symptoms

6.1 - Coolant Contaminated

Overview

Check for contamination of the coolant in the deaeration tank.

WARNING: To prevent personal injury or death, wear protective clothing when handling oil / fluids.

Possible Causes

- Oil cooler
- Diesel Exhaust Fluid (DEF) Tank Heater lines

Test Procedure

Step 1	Determine coolant quality.	Decision
Perform the Coolant Quality Inspection (page 2356)procedure. Is the coolant contaminated with Lube Oil or Diesel Exhaust Fluid (DEF)?		Yes: Lube oil, go to Step 3. Yes: DEF, go to Step 2.
		No: Review complaint.

Step 2	Sample coolant in the DEF.	Decision
Use the Diesel Exhaust Fluid (DEF) refractometer to test DEF purity. Check for signs of coolant and DEF discoloration. Coolant in the DEF tank is a sign the DEF-tank coolant loop has a leak that could allow DEF to enter the loop and get transferred to the deaeration tank. Is the DEF contaminated with coolant?		Yes: Pressure test cooling system. Go to Cooling System Pressure Test (page 2314). Find leak and make repair to coolant lines in DEF tank.
		No: Review steps and ensure proper decision was made. Review complaint.

Step 3	Determine oil cooler pressure.	Decision
Perform the Oil Cooler Pressure Test (page 2334). Did the oil cooler assembly pass the pressure test?		Yes: Review steps and ensure proper decision was made. Review complaint.
		No: Replace the oil cooler assembly.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.2 - Coolant Loss

Overview

Diagnose loss of coolant from the cooling system.

Possible Causes

- Failed deaeration tank cap
- External leaks
- Coolant overflow
- Coolant leak to exhaust
- Coolant leak to intake
- Coolant leak to lube oil

Test Procedure

Step 1	Coolant quality inspection.	Decision
Perform the Coolant Quality Inspection (page 2356)procedure. Does the system pass inspection?		Yes: Go to Step 2.
		No: Repair as needed and then go to Step 2.

Step 2	Deaeration Tank Cap Inspection and Pressure Test.	Decision
Perform the Deaeration Tank and Cap Test (page 2311). Does the cap pass the inspection?		Yes: Go to Step 3. (page 89)
		No: Replace the cap and then go to Step 3.

Step 3	Pressure Test Cooling System – Visual Leak Check.	Decision
Perform Coolant Level and Leak Inspection (page 2360). Are there visible coolant leaks?		Yes: Repair as needed. Diagnostics complete.
		No: Go to Step 4.

Step 4	Coolant Overflow / Over-Temperature Test.	Decision
Perform the Coolant Overflow/Over-Temperature Test (page 2318). Does coolant overflow or over-temperature symptom occur?		Yes: Overflow: Go to the Step 4 in Coolant Overflow (page 94)symptom work package. Yes: Over-Temperature: Go to Step 2 in the Coolant Over Temperature (page 91) symptom work package.
		No: Go to Step 5.

Step 5	Coolant to Exhaust Inspection.	Decision
Perform the Coolant in Exhaust Inspection (page 2357). Is there coolant visible in the exhaust?		Yes: Go to Step 2 of Coolant in Exhaust (page 97)symptom work package.
		No: Go to Step 6.

Step 6	Coolant in Lube Oil Check.	Decision
Remove the engine oil level gauge. Check for coolant mixed into the engine oil. Oil and coolant mixed will be thickened and coagulated, and have a light gray sludgy appearance. Is there coolant in the oil?		Yes: Take a sample of the oil for analysis and then go to Step 2 of the Coolant to Lube Oil (page 102) symptom work package.
		No: Go to Step 3 of Coolant to Intake (page 101) symptom work package.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.3 - Coolant Over-Temp

Overview

Diagnose cooling system that exceeds normal operating temperature.

 **WARNING: To prevent personal injury or death, wear safety glasses with side shields.**

Possible Causes

- Deaeration tank
- Low coolant level
- Coolant leaks
- External radiator air blockage
- Internal radiator coolant flow blockage
- Accessory drive belt
- Thermostat
- Belt tensioner
- Fan clutch
- Water pump
- Cooling fan
- Gauge error
- Incorrect radiator
- Fan shroud damaged or missing
- Coolant concentration (freeze point)

Test Procedure

Step 1	Check coolant level, contamination, and quality.	Decision
Perform the Coolant Quality Inspection (page 2356)procedure. Does coolant overflow pass inspection?		Yes: Go to Step 2 (page 92). No: Repair as needed and then go to Step 2 (page 92).

Step 2	Determine if cooling system over-flow or over-temperature occurs.	Decision
Perform the Coolant Over-Flow / Over-Temperature Test (page 2318). Does coolant overflow occur?		Yes, Overflow: Go to Coolant Overflow (page 94). No: Go to Step 3.

Step 3	Cooling System Component Inspection.	Decision
Inspect the cooling system components for visible failure or damage. Are failed components detected?		Yes: Repair as needed, refill cooling system (if previously drained), and then repeat Step 2. No: Go to Step 4.

Step 4	Compare Engine Coolant Temperature 1 (ECT1) to instrument panel temperature gauge.	Decision
Perform the Instrument Panel Temperature Gauge Validation Test (Instrument Cluster Temperature Gauge Validation Test, page 2332). Did the temperature gauge and ECT1 values match as the engine warms up to normal operating range?		Yes: Go to Step 5. No: Repair as needed, and then repeat Step 2.

Step 5	Determine if thermostat is opening at appropriate temperature.	Decision
Is the thermostat functioning properly?		Yes: Go to Step 6. No: Repair as needed, refill cooling system, and then repeat Step 2.

CAUTION: To prevent radiator damage, do not hold direct high pressure water or air close to the radiator fins.

Step 6	Exterior Radiator Flush.	Decision
Visually Inspect the radiator and clean to ensure there is sufficient airflow. Was airflow through the radiator restricted?		Yes: Repeat step 2. No: Go to Step 7 (page 92).

Step 7	Fan Clutch Engagement Test.	Decision
Run engine up to operating temperature. Does fan clutch engage at the correct temperature?		Yes: Go to Step 8.
		No: Repair as needed, refill cooling system (if previously drained), and then repeat Step 2.

Step 8	Water Pump Inspection.	Decision
Perform the Water Pump Inspection procedure in *Engine Service Manual*. Is the impeller, shaft, pump housing, front cover, or the pump bearing damaged?		Yes: Repair as needed, refill cooling system (if previously drained), and then repeat Step 2.
		No: Go to Step 9.

Step 9	Radiator Flow Test.	Decision
Remove radiator and have it flushed and flow-tested at a radiator repair facility.		Repair as needed, refill cooling system, and then repeat Step 2.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.4 - Coolant Overflow

Overview

Diagnose coolant overflowing from the cooling system.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

Possible Causes

- Deaeration cap
- Deaeration tank
- Air compressor
- Cylinder head
- Injector sleeve
- Head gasket
- Cylinder sleeve (cavitation or cracks)

Test Procedure

Step 1	Check coolant level, contamination and quality.	Decision
Perform Coolant Quality Inspection (page 2356) procedure. Does cooling system pass inspection?		Yes: Go to Step 2.
		No: Repair as needed and then go to Step 2.

Step 2	Determine if deaeration tank and cap will hold pressure.	Decision
Perform Deaeration Tank and Cap Test (page 2311). Does deaeration cap and tank seal properly?		Yes: Go to Step 3.
		No: Repair or replace tank or cap as needed, then go to Step 3.

Step 3	Determine if cooling system over-flow or over-temperature occurs.	Decision
Perform Coolant Over-Flow/Over-Temperature Test (page 2318). Does coolant overflow occur?		Yes, Overflow: Go to Step 4 (page 95).
		No: Over-Temperature: Go to Coolant Over Temperature (page 91) .

Step 4	Determine if air compressor is causing cooling system overflow.	Decision
Perform Air Compressor Overflow Test (page 2324). Is the air compressor pressurizing the cooling system?		Yes: Repair or replace air compressor. Go to Step 11 (page 96). No: Go to Step 5.

Step 5	Determine if fuel injector sleeves or cylinder head are leaking.	Decision
A. Remove cylinder head. B. Perform Cylinder Head Pressure Test in the *Engine Service Manual*. Are any fuel injector sleeves, or the cylinder head leaking?		Yes: Replace leaking fuel injector sleeves, or leaking cylinder head then go to Step 11 (page 96). No: Go to Step 6.

Step 6	Determine if cylinder sleeves have cavitation or cracks.	Decision
Perform Cylinder Sleeve Cavitation and Crack Inspection (page 2388) procedure. Are any cylinder sleeves cracked or damaged by cavitation?		Yes: Replace damaged cylinder sleeves as needed. Go to Step 11 (page 96). No: Go to Step 7.

Step 7	Determine if engine cylinder head is cracked.	Decision
Perform Inspecting Cylinder Head for Cracks in the *Engine Service Manual*. Is cylinder head cracked?		Yes: Replace cylinder head. Go to Step 11 (page 96). No: Go to Step 8.

Step 8	Determine if cylinder head gasket surface is warped.	Decision
Perform Measuring Cylinder Head Warpage procedure in *Engine Service Manual* and compare measurements to cylinder head gasket surface flatness specifications. Is cylinder head gasket surface flatness within specifications?		Yes: Go to Step 11. No: Go to Step 10.

Step 9	Measure cylinder head thickness to determine if cylinder head can be resurfaced.	Decision
Perform Measuring Cylinder Head Thickness procedure in *Engine Service Manual* and compare measurements to Cylinder head thickness specifications. Will cylinder head exceed minimum cylinder head thickness after resurfacing?		Yes: Resurface the cylinder head. Go to Step 11. No: Replace the cylinder head. Go to Step 11.

Step 10	Measure cylinder sleeve protrusion.	Decision
Perform Measuring Cylinder Sleeve Protrusion procedure in *Engine Service Manual*. Are Cylinder sleeve protrusion and Cylinder sleeve protrusion difference between all six sleeves within specification?		Yes: Go to Step 11.
		No: Correct liner protrusion and assemble engine. Go to Step 11.

Step 11	Reassemble and use Coolant Management Tool to fill cooling system.	

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.5 - Coolant Leak to Exhaust

Overview

Diagnose evidence of coolant in the exhaust.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

Possible Causes

- Injector sleeve
- Cylinder head
- Exhaust Gas Regulator (EGR) cooler

Test Procedure

Step 1	Check for Coolant in Exhaust.	Decision
Perform the Coolant in Exhaust Inspection (page 2357) procedure. Is there EGR coolant visible in the exhaust pipe or exhaust brake valve housing?		Yes: Go to Step 2. No: Go to Coolant Loss (page 89) symptom.

Step 2	Exhaust Gas Regulator (EGR) Cooler Pressure Test.	Decision
Perform the On-Engine EGR Cooler Leak Test (page 2329). Does the cooler leak internally?		Yes: Replace EGR cooler. After repairs are complete, retest for original problem. No: Go to Step 3.

Step 3	Injector Sleeve and Cylinder Bore Inspection.	Decision
A. Inspect cylinder head on engine. B. Remove injectors and pressurize cooling system. C. Look for leakage. Is coolant leaking into the cylinders?		Yes: Replace Leaking Injector Sleeves. After repairs are complete, retest for original complaint. No: Go to Step 4.

Step 4	Determine if fuel injector sleeves or cylinder head are leaking.	Decision
A. Remove cylinder head. B. Replace the injector sleeve on any cylinder (see *Engine Service Manual*) with signs of coolant entering the cylinder or the injector sleeve leaking, and then retest. Does the cylinder head leak at the casting or any injector sleeves leak coolant?		Yes: Replace leaking injector sleeves or replace leaking cylinder head. After repairs are complete, retest for original problem. No: Got to Step 7.

Step 5	Determine if engine cylinder head is cracked.	Decision
Perform Inspecting Cylinder Head for Cracks Procedure in the *Engine Service Manual*. Is the Cylinder head cracked?		Yes: Replace cylinder head. Go to Step 8. No: Go to 7.

Step 6	Determine if cylinder head gasket surface is warped.	Decision
Perform Measuring Cylinder Head Warpage Procedure in the *Engine Service Manual* and compare measurements to cylinder head gasket surface flatness specifications. Is cylinder head gasket surface flatness within specifications?		Yes: Go to Step 8. No: Go to Step 7.

Step 7	Measure cylinder head thickness to determine if cylinder head can be resurfaced.	Decision
Perform Measuring Cylinder Head Thickness Procedure in the *Engine Service Manual* and compare measurements to cylinder head thickness specifications. Will cylinder head exceed minimum cylinder head thickness after resurfacing?		Yes: Replace the cylinder head. Go to Step 8. No: Replace the cylinder head and go to Step 8.

Step 8	Measure cylinder sleeve protrusion.	Decision
Perform Measuring Cylinder Sleeve Protrusion Procedure in the *Engine Service Manual*. Are Cylinder sleeve protrusion and Cylinder sleeve protrusion difference between all six sleeves within specification?		Yes: Assemble engine and use Coolant Management Tool to fill cooling system. No: Correct liner protrusion and assemble engine. Use Coolant Management Tool to fill cooling system.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.6 - Coolant Leak to Intake

Overview

Diagnose coolant loss to intake piping or manifold.

Possible Causes

- Exhaust Gas Recirculation (EGR) cooler
- Interstage cooler

Test Procedure

Step 1	Check for interstage cooler leak to intake.	Decision
Perform Interstage Cooler Inspection (page 2358). Is there coolant or coolant residue in the interstage cooler elbow or turbocharger compressor intake housing?		Yes: Replace interstage cooler. After repairs are complete, retest for original problem.
		No: Go to Step 2.

Step 2	Determine if EGR cooler is leaking.	Decision
Perform On-Engine EGR Cooler Leak Test (page 2329). Does the EGR cooler leak?		Yes: Replace EGR Cooler. After repairs are complete, retest for original problem.
		No: Re-evaluate cooling system for leaks to intake.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

6.7 - Coolant Leak to Lube Oil

Overview

Diagnose loss of coolant from the cooling system into the lube oil system.

Possible Causes

- Oil cooler
- Air compressor
- Cylinder head cup plugs
- Cylinder head cup plugs (intake side)
- Front cover gasket and O-rings
- Injector sleeves
- Cylinder head
- Head gasket
- Liner O-rings

Test Procedure

Step 1	Lube oil level and contamination check.	Decision
Perform the Engine Oil and Quality Check (page 2353). Is the lube oil contaminated with coolant?		Yes: Go to Step 2. No: Take an oil sample for analysis. Examine evidence of coolant loss and coolant in the oil.

Step 2	Air Compressor Coolant Leak Test.	Decision
Perform the Air Compressor Coolant Leak Test (page 2324). Is the air compressor leaking coolant into the oil pan?		Yes: Relieve the system pressure and replace the air compressor. Go to step 15 (page 105). No: Go to step 3 (page 102).

Step 3	Coolant to Oil Sump Inspection.	Decision
Perform the Coolant to Oil Sump Inspection (page 2385) Procedure. Is the air compressor leaking coolant into the oil pan?		Yes: Coolant is leaking down the coolant side of the liner, go to step 13 (page 105). Yes: Coolant is leaking down the piston side of the liner, go to step 6 (page 103).

	Yes: Coolant is leaking from the cylinder head oil drain holes (push tube holes), go to step 7 (page 104).
	Yes: Coolant is leaking from the front cover drain area, go to step 9.
	No: Maintain pressure on the cooling system and go to step 4.

Step 4	Coolant to Oil Sump Inspection	Decision
Keep the cooling system under pressure for 2 hours, and then inspect for coolant leaking into the oil pan. Is coolant leaking to the oil pan?		Yes: Coolant is leaking down the coolant side of the liner, go to step 14.
		Yes: Coolant is leaking down the piston side of the liner, go to step 5.
		Yes: Coolant is leaking from the cylinder head oil drain holes (Push tube holes), go to step 6 (page 103).
		Yes: Coolant is leaking from the front cover drain area, go to step 8 (page 104).
		No: Go to step 8 (page 104).

Step 5	Injector Sleeve Replacement.	Decision
A. Relieve pressure on the cooling system. B. Perform the Injector Sleeve Replacement procedure in the *Engine Service Manual* on cylinders showing leakage between the liner and the piston. Is the coolant leakage into the cylinder(s) resolved?		Yes: Go to step 15 (page 105).
		No: Go to step 10 (page 104).

Step 6	Internal Cup Plug Inspection.	Decision
Perform the Cylinder Head internal leak Inspection in the *Engine Service Manual.* Was a cup plug under the valve cover leaking or was the cylinder head cracked?		Cup plug: Relieve pressure on the cooling system. Repair as needed and then go to step 15 (page 105). Head crack: Replace the cylinder head and then go to step 15 (page 105).

Step 7	Intake Side Cup Plug Inspection.	Decision
A. Remove intake manifold. B. Check intake side cup plugs and intake ports for evidence of coolant and coolant residue. Are leaking cup plugs located?		Yes: Repair as needed and then go to step 15 (page 105). No: Go to step 9.

Step 8	Front Cover Coolant Leak Inspection.	Decision
A. Relieve pressure on the cooling system. B. Perform the Front Cover Coolant Leak Inspection procedure in the *Engine Service Manual.* Is the front cover damaged or are the seals and gaskets leaking?		Front cover damaged: Replace front cover, gaskets, and seals and then go to step 15 (page 105). Seals and gaskets leaking: Reassemble the front cover with new seals and gaskets, and then go to step 15 (page 105).

Step 9	Cylinder Head Dye Penetrant Inspection.	Decision
Remove the cylinder head and perform the Cylinder Head Dye Penetrant Inspection in the *Engine Service Manual.* Was a crack detected?		Yes: Replace the cylinder head and then go to step 15 (page 105). No: Go to step 11.

Step 10	Cylinder Head Leak Test.	Decision
Perform the Cylinder Head Leak Test in the *Engine Service Manual.* Was an injector sleeve leak or internal casting leak detected?		Yes: Injector Sleeve Leak: Replace leaking sleeves and repeat pressure test. If cylinder head passes the retest, go to step 15 (page 105). Yes: Internal Leak: Replace cylinder head

	and go to step 15 (page 105).
	No: Go to step 12.

Step 11	Cylinder Head Warp Measurement.	Decision
Perform the Cylinder Head Warp Measurement procedure in the *Engine Service Manual.* Is the cylinder head warped?		Yes: Go to step 15 (page 105). No: Reexamine evidence of cylinder head causing coolant leak to lube oil.

Step 12	Cylinder Head Thickness Measurement.	Decision
Perform the Cylinder Head Thickness Measurement procedure in the *Engine Service Manual.* Can the head be surfaced?		Yes: Machine or cylinder head as needed. Go to step 15 (page 105). No: Replace cylinder head and go to step 15 (page 105).

Step 13	Cylinder Sleeve O-ring Replacement.
A. Relieve pressure on the cooling system. B. Replace the cylinder sleeve O-rings as needed. C. Go to step 15 (page 105).	

Step 14	Cylinder Sleeve Protrusion Measurement.	Decision
Check cylinder sleeve protrusion (see *Engine Service Manual*). Is cylinder sleeve protrusion within specifications?		Yes: Go to step 15 (page 105). No: Correct liner protrusion and then go to step 15 (page 105).

Step 15
A. Reassemble engine. B. Change the engine oil, oil filter, and the centrifugal oil filter (If equipped). Diagnostics and repair complete.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Engine Lubrication Symptoms

7.1 - Lube Oil Contamination

Overview

Diagnose contamination of the engine lube oil.

Possible Causes

- Coolant leak to oil
- Oil contaminated with foreign liquids by poor service error

Test Procedure

Step 1	Inspect engine lube oil level, and inspect oil for contamination.	Decision
Perform Engine Oil and Quality Check (page 2353). Is engine oil level to specification and not contaminated?		Yes: Review operator complaint.
		No: Go to step 2.

Step 2	Take engine oil sample and inspect for contamination.	Decision
A. Take engine oil sample. B. Inspect sample for coolant and Diesel Engine Fuel (DEF) contamination. Is the oil contaminated with coolant or DEF?		Yes: Go to Coolant Leak to Lube Oil (page 102), or repair DEF leak to engine oil.
		No: Review operator complaint.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

7.2 - Lube Oil to Coolant

CONTENT
UNDER
DEVELOPMENT

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7.3 - Engine Oil to Intake

Overview

Diagnose engine oil in the air intake system.

Possible Causes

- High-Pressure (HP) turbocharger
- Low-Pressure (LP) turbocharger

Test Procedure

Step 1	High-Pressure Charge Air Cooler (HPCAC) intake pipe inspection.	Decision
A. Remove the HPCAC intake pipe. B. Inspect the pipe and turbocharger outlet for oil residue. Is oil residue present in the pipe or the turbocharger outlet?		Yes: Go to Step 2 (page 109). No: Review complaint.

Step 2	Low-Pressure (LP) turbocharger compressor outlet pipe inspection.	Decision
A. Remove the LP turbocharger compressor outlet pipe. B. Inspect the LP compressor outlet for oil residue. Is there oil residue in the LP turbocharger outlet?		Yes: Replace LP turbocharger, and clean or replace the interstage cooler as needed. Go to Step 3 (page 110). No: Replace High Pressure (HP) turbocharger. Go to Step 4 (page 110).

Step 3	HP turbocharger inspection.	Decision
A. Remove the HP Turbocharger compressor intake pipe. B. Perform the HP Turbocharger Radial and Axial Play Inspection (page 2392) procedure. Is axial play out of specification or does the compressor wheel make contact with any point of the compressor housing?		Yes: Replace HP turbocharger and then go to Step 4 (page 110). No: Go to Step 4 (page 110).

Step 4	Charge Air Cooler cleaning (CAC).
A. Clean the High-Pressure Charge Air Cooler (HPCAC) using Cleaning Management System (12-353-01) and CAC Adapter Flushing Kit (09-925-01). B. If LP turbocharger was replaced, clean the interstage cooler (if equipped). C. Clean the CAC pipes.	

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

7.4 - Engine Oil to Exhaust

Overview

Diagnose engine lube oil in the exhaust system.

WARNING: To prevent personal injury or death, allow engine to cool before working with components.

Possible Causes

- High-Pressure (HP) Turbocharger
- Low-Pressure (LP) Turbocharger
- Internal engine damage

Test Procedure

Step 1	Determine if cylinder relative compression is within specification.	Decision
Perform Relative Compression Test (page 2167). Do one or more cylinders have significant speed difference(s) than others?		Yes: Check for internal engine damage (cylinder damage may result in oil in the exhaust). After repairs are complete, retest for original problem.
		No: Go to Step 2.

Step 2	High-Pressure (HP) Turbocharger Inspection.	Decision
• Perform High-Pressure Turbocharger Center Section Removal process in the *Engine Service Manual*. • Inspect the turbine wheel and turbine housing for oil residue. Is there an oil residue on the turbine wheel or in the turbine housing?		Yes: Install a new HP-Turbocharger center section. After repairs are complete, retest for original problem.
		No: Go to Step 3.

Step 3	Low-Pressure (LP) Turbocharger Inspection.	Decision
Remove the Exhaust Back Pressure Valve (EBPV) assembly. Inspect turbocharger low-pressure turbine outlet for lube oil. Is lube oil present?		Yes: Replace LP-Turbocharger assembly. After repairs are complete, retest for original problem.
		No: Review operator complaint.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

7.5 - Power Steering Fluid Leak to Lube Oil

CONTENT
UNDER
DEVELOPMENT

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7.6 - Low Oil Pressure

Overview

Diagnose low engine oil pressure.

WARNING: To prevent personal injury or death, do not smoke near fuel and keep fuel away from flame and sparks.

Possible Causes

- Oil level (low or high)
- Aerated oil
- Pickup tube gasket
- Fuel-diluted oil
- Cracked pickup tube
- Oil pump
- External leaks
- Incorrect oil viscosity
- Biased Engine Oil Pressure (EOP) sensor
- Piston cooling jets
- Loose rocker arm bolt
- Worn rocker arms or shaft
- Bearing inserts (main and rod)
- Incorrect oil pressure gauge
- Camshaft bushing
- Bearing inserts (main and rod)

Test Procedure

Step 1	Inspect engine oil level and contamination.	Decision
Perform Engine Oil and Quality Check (page 2353) . Is engine oil level low or contaminated?		Yes, oil level is low: add oil to correct level. Record amount of oil added. Go to step 2.
		Yes, oil level is high: Drain oil to appropriate level. Go to step 2.
		Yes, oil is contaminated: go to Engine Oil Contaminated (page 107).
		No: Go to step 2.

Step 2	Determine if engine oil is aerated.	Decision
A. Run engine for 2 minutes at idle. B. Turn engine off. C. Remove Engine Oil Temperature (EOT) sensor. D. Inspect engine oil for foaming and aeration. E. Reinstall EOT. Is engine oil aerated or foaming?		Yes: Go to Step 3. No: Go to Step 4.

Step 3	Inspect engine oil system for damage and external leaks.	Decision
A. Inspect engine oil pan, oil cooler module, oil filter assembly, turbocharger oil supply lines, air compressor, high-pressure oil pump, valve cover, and front cover for damage or leaks. B. Inspect for external engine oil leaks. Are there external engine oil leaks or oil system damage?		Yes: Repair damage or leaks. After repairs are complete, retest for original problem. No: Go to Step 4.

Step 4	Determine if manual gauge, ServiceMaxx™, and instrument panel oil pressure gauge readings meet specification and match.	Decision
Perform Instrument Panel Engine Oil Pressure Gauge Validation Test (page 2340). Does engine oil pressure meet specifications on the Pressure Test Kit (manual) gauge, ServiceMaxx™, and instrument panel gauge?		Yes: Re-examine complaint. No: If manual gauge and ServiceMaxx™ software do not match, diagnose EOP sensor and circuits (page 1152). No: If manual gauge, ServiceMaxx™ software, and instrument panel gauge match but are below specifications, go to Step 5.

Step 5	Determine if oil pressure regulator is operating properly.	Decision
Perform Oil Pressure Regulator Inspection (page 2386). Is oil pressure regulator working correctly?		Yes: Go to Step 6. No: Replace oil pressure regulator. After repairs are complete, retest for original problem.

Step 6	Determine if internal engine lubrication system components are broken, leaking or out of specification.	Decision
Perform Oil and Crankcase Inspection (page 2389) to help determine if the oil pickup tube, oil pick up tube gasket, piston cooling jets, camshaft bushings, main bearings, rod bearings, or oil pressure regulator valve are broken, leaking or out of specification. Are any internal engine parts damaged or out of specification?		Yes: Adjust or repair as needed. After repairs are complete, retest for original problem. No: Go to Step 7.

Step 7	Determine if engine oil pump is damaged, worn or out of specification.	Decision
A. Inspect the engine oil pump housing and plate for gouging, scoring, or a discolored hot-scored appearance. B. Inspect the gerotor gears for excessive wear or damage. C. Perform Measuring Oil Pump Side Clearance and Measuring Oil Pump End Clearance in the *Engine Service Manual.* D. Inspect front cover for leaks or damage. Is engine oil pump out of specification, worn, or damaged?		Yes: Replace oil pump. After repairs are complete, retest for original problem. No: Go to Step 8.

Step 8	Determine if rocker shaft or rocker arms are out of specification or damaged.	Decision
Perform Inspection and Measurement of Rocker Arms and Measuring Rocker Shaft in the *Engine Service Manual.* Are rocker arms or rocker shaft out of specification or damaged?		Yes: Replace components as needed. After repairs are complete, retest for original problem. No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

7.7 - High Oil Pressure

Overview

Diagnose high engine lube oil pressure.

Possible Causes

- Dash gauge
- Sensor and sensor circuits
- Pressure regulator valve
- Contaminated oil
- Incorrect oil viscosity
- Restricted oil module drain port

Test Procedure

Step 1	Oil level and contamination check.	Decision
Perform the Engine Oil and Quality Check (page 2353). Is the oil level low or contaminated?		Yes: Low: Add oil to correct the level. Record the amount of oil added. Go to Step 2 (page 117).
		Yes: Contaminated: Do not continue. Thickened oil may cause high oil pressure. Go to Lube Oil Contaminated symptom (7.1 - Lube Oil Contamination, page 107).
		No: Go to Step 2 (page 117).

Step 2	Manual gauge pressure check.	Decision
Perform the Oil Pressure Verification Test (page 2337) and Instrument Panel Engine Oil Pressure Gauge Validation Test (page 2340). Does oil pressure meet the specification?		Yes: Review complaint. Notify supervisor for further action.
		No: ServiceMaxx™ software and dash gauge do not match: Diagnose instrument panel engine oil pressure gauge.
		No: Manual gauge and ServiceMaxx™ software do not match: Diagnose sensor and circuits.
		No: Gauge, ServiceMaxx™ software, and dash match, but are above specifications. Go to Step 3 (page 117).

Step 3	Oil pressure regulator inspection.	Decision
Perform the Oil Pressure Regulator Inspection (page 2386) procedure. Is the oil pressure regulator working correctly?		Yes: Go to Step 4 (page 117).
		No: Replace the regulator. Retest the oil pressure. If pressure is correct go to Step 5 (page 118). If pressure is still high, go to Step 4 (page 117).

Step 4	Oil relief valve and crankcase inspection.	Decision
Remove oil filter module (see *Engine Service Manual*) and inspect oil relief valve passage to crankcase for foreign material. Is there foreign material or a blockage in crankcase relief passage?		Yes: Remove debris, install oil filter module (see *Engine Service Manual*), and retest. If pressure is correct, go to Step 5 (page 118).
		No: Review complaint and ensure correct decisions and good inspections were made.

Step 5
Reassemble engine.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

7.8 - Excessive Oil Consumption

CONTENT
UNDER
DEVELOPMENT

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Fuel System Symptoms

8.1 - Fuel Delivery Pressure

Overview

Diagnosis fuel delivery pressure low or high problem.

WARNING: To prevent personal injury or death, keep fuel away from flame and sparks.

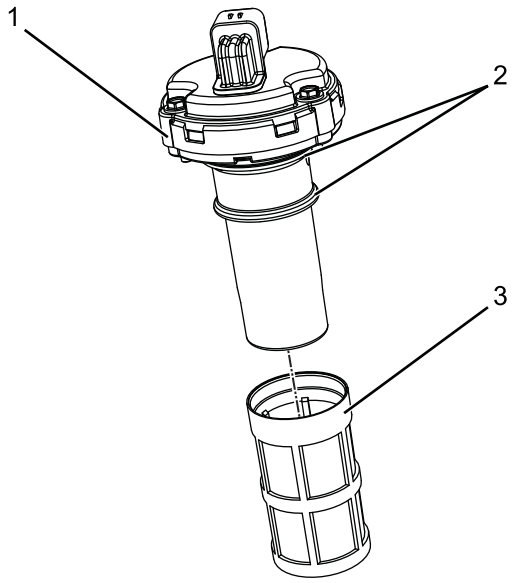
Possible Causes

- Low / no fuel in fuel tanks(s)
- Restricted fuel strainer
- Fuel filter restriction
- Fuel gelling in cold weather
- Fuel inlet restriction or leak (supply line, tank, pickup, optional primary fuel filter)
- Restricted fuel return line
- Electric fuel pump power, ground, or relay circuits
- Failed fuel pressure regulator
- Leaking or damaged fuel supply or return fittings
- Incorrect fuel pump O-rings
- Failed fuel pump

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 8.0 Fuel System Operational Checkout Procedure (page 40)?		Go to Step 2.
		Go to 8.0 Fuel System Operational Checkout Procedure (page 40).

Step 2	Measure fuel delivery pressure	Decision
Perform Fuel Delivery Pressure (FDP) Test (page 2273). Did fuel delivery pressure meet specification?		No, Less than specification: Go to Step 3.
		No, Greater than specification: Go to Step 8.
		Yes: End Diagnostic Steps.



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Figure 7 Fuel Pump and O-rings

1. Electric Fuel Pump
2. Brown fuel pump O-rings
3. Fuel strainer

Step 3	Inspect fuel filter, fuel strainer, and fuel pump O-rings.	Decision
A. Disconnect fuel inlet from engine mounted fuel filter module. B. Inspect and clean fuel inlet fitting of debris. C. Turn Key On for 20 seconds (to reduce fuel in filter module). D. Turn Key Off. E. Remove and inspect engine mounted fuel filter. F. Remove and inspect fuel pump, strainer, and O-rings. **Low fuel delivery pressure, hard to start, or no start can be caused by non-Original Equipment Manufacturer (OEM) fuel filters and / or wrong O-rings installed on the fuel pump.** Is fuel filter made by a Navistar International approved manufacturer? Is fuel filter and strainer clean, and are fuel pump O-rings brown?		Yes: Go to Step 4. No: Install Navistar International approved fuel filter. Clean or replace fuel strainer. Install proper brown O-rings on fuel pump. After repairs are complete, retest for original problem.

Electronic Fuel Pump

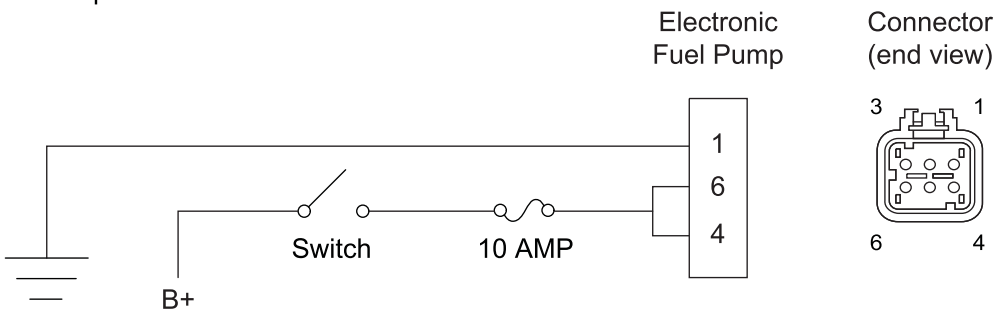


Figure 8 Electronic Fuel Pump PWR and GND

Step 4	Determine if fuel pump will run when provided power and ground.	Decision
CAUTION: Use a 10 amp fuse in the circuit, in case pump is shorted. With fuel pump removed from engine, provide power and ground to the pump: A. Install Fuel Pump Breakout Harness - ZTSE6023 on fuel pump connector, leave engine harness disconnected. B. Install power circuit with 10 amp fuse to pins-4 and 6. C. Ground pin-1. D. Listen for pump running. Let pump run for 30 seconds. Does pump run?		Yes: Reinstall fuel pump. Go to Step 5. No: Replace electric fuel pump. After repairs are complete, retest for original problem.

Step 5	Determine if electric fuel pump power and ground circuits are operating properly.	Decision
Perform Fuel Pump Voltage Test (page 2276). Is voltage reading between Pin-6 and Pin-1, and between Pin-4 and Pin-1 within 0.5 volt of battery voltage when the fuel pump is energized?		Yes: Go to Step 7. No: Leave Breakout Harness connected. Go to Step 6.

Step 6	Determine if electric fuel pump power and ground circuits are operating properly.	Decision
Using a Digital Multimeter (DMM) measure voltage between pin-4 and ground, and between pin-6 and ground, when fuel pump is commanded on. Key must be Off for 10 seconds, or more, and then cycled On for Electronic Control Module (ECM) to command fuel pump On. Is voltage at pins 4 and 6 within 0.5 volts of battery voltage?		Yes: Repair electric fuel pump ground circuit. After repairs are complete, retest for original problem. No: Repair electric fuel pump power circuit. After repairs are complete, retest for original problem.

Step 7	Determine if fuel inlet problem is present.	Decision
Perform the Clean Fuel Source Test (page 2279). Inspect for debris at fuel inlet, clean as needed. Is fuel pressure now greater than minimum Key-On Engine-Off (KOEO) specification?		Yes: Repair restriction in fuel supply line, pickup, fuel tank, or optional chassis mounted fuel filter. After repairs are complete, retest for original problem.
		No: Replace Fuel Pressure Regulator (see *Engine Service Manual*). After repairs are complete, retest for original problem.

Step 8	Determine if fuel return line is restricted.	Decision
A. Check vehicle fuel return line from the fuel filter module fitting to the fuel tank for restrictions. B. Connect Clean Fuel Source Tool Return Line 15-637-01-3 to the fuel filter module fuel return port. C. Start engine. Is fuel pressure now within specification?		Yes: Repair fuel return restriction. After repairs are complete, retest for original problem.
		No: Inspect that fuel filter module dry break fitting opens when return line fitting is attached. After repairs are complete, if fuel pressure is still high, replace fuel pressure regulator. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

8.2 - Fuel in Engine Oil

CONTENT
UNDER
DEVELOPMENT

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Engine Brake Symptoms

9.1 - Engine Compression Brake Inoperative

Possible Causes

- Incorrect brake lash adjustment
- Brake (oil) pressure relief valve stuck open
- Brake Control Pressure (BCP) leak (worn brake piston seals, etc.)
- Failed Engine Compression Brake 1 (ECB1) Valve
- Engine compression brake switch or circuit inoperative (switch, circuit or body controller could not enable brake due to not receiving required signals)
- Engine compression brake control system entry conditions not met

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 9.0 Engine Compression Brake Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 9.0 Engine Compression Brake Operational Checkout Procedure (page 41).

Step 2	Determine if Brake Ctrl Pressure Desired goes above 0 when commanded.	Decision
Review 0 to 60 snapshot. Did Brake Ctrl Pressure Desired go above 0?		Yes: Go to Step 6
		No: Go to Step 3

Step 3	Check for Accelerator Pedal Position (APP) or Transmission Output Shaft Speed (TOSS) Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: • SPN 91 and 2623 APP • SPN 191 TOSS Is SPN 91, 191, or 2623 active?		Yes: Got to Fault Code Diagnostics for SPN 91,191 or 2623
		No: Go to Step 4

Step 4	Verify all operator controls are set properly to allow engine brake operation.	Decision
Verify the following are true: • Traction Control is not active • Clutch pedal is released • Cab mounted engine brake ON/OFF switch is set to ON • Accelerator pedal is not depressed • Vehicle transmission is in gear (driveline engaged) • Torque Convertor lockup engaged • Engine Oil temperature is greater than 25° C (77° F) • Anti-lock Brake System (ABS) not active • Engine speed is greater than 1000 RPM Are all the above conditions true?		Yes: Go to Step 5 No: Bring all operator controlss to proper condition to allow engine compression brake operation. After repairs are complete, retest for original problem.

Step 5	Determine if programmable parameter is enabled to allow engine compression brake operation.	Decision
A. Connect EST with ServiceMaxx™ and log-in B. Select Sessions > Programming C. Select the Engine Brake tab Is Vehicle Retarder Control Mode programmable parameter enabled?		Yes: Go to Step 6 No: Enable Vehicle Retarder Control Mode programmable parameter. After repairs are complete, retest for original problem.

Step 6	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
Review 0 to 60 snapshot: verify Injection Control Pressure is approximately the same as ICP Desired. Is Injection Control Pressure approximately the same as ICP Desired?		Yes: Go to Step 7 No: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227).

Step 7	Determine if ICP system is operating properly.	Decision
Review 0 to 60 snapshot: Verify ICP Ctrl is less than 80% Is ICP Ctrl less than 80%?		Yes: Go to CPA High-Pressure Oil Pump (HPOP) Test (page 2227). No: Check and adjust brake lash. Then retest operation.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify supervisor for further action.

9.2 - Engine Compression Brake Engaged When Not Commanded

Possible Causes

- Failed high-pressure oil manifold
- Brake pressure relief valve stuck shut
- Engine Compression Brake 1 (ECB1) solenoid stuck open or leaking
- Engine Compression Brake 1 (ECB1) circuit fault
- Incorrect brake lash adjustment
- BCP sensor or circuit fault

Test Procedure

Step 1	Perform operational checkout procedure.	Decision
Did you perform 9.0 Engine Compression Brake Operational Checkout Procedure?		Yes: Go to Step 2
		No: Go to 9.0 Engine Compression Brake Operational Checkout Procedure (page 41).

Step 2	Determine if Brake Ctrl Pressure is approximately the same as Brake Ctrl Pressure Desired.	Decision
Review 0 to 60 snapshot Is Brake Ctrl Pressure below 100 psi, when Brake Ctrl Pressure Desired is 0?		Yes: adjust engine brake lash see *Engine Service Manual*. After repairs are complete, retest for original problem.
		No: Do BCP sensor and circuit checks (SPN 4287 Pin-Point Tests). If checks are good, Go to Step 3.

CAUTION: See latest version of *N9 and N10 Engine and Aftertreatment Wiring Schematic* Form 0000003481 for additional circuit information.

Step 3	Determine if Engine Compression Brake 1 (ECB1) circuits are operating properly.	Decision
Check ECB1-L and ECB1-H circuits for Open, short to ground, or short to power.		Yes: Go to Step 4
Are ECB1-L and ECB1-H circuits operating properly?		No: Repair circuit(s). After repairs are complete, retest for original problem.

Step 4	Determine if ECB1 actuator or O-rings are leaking or damaged.	Decision
A. Remove ECB1 actuator. See *Engine Service Manual* B. Check ECB1 actuator and O-rings for leaks or damage Is ECB1 actuator or O-rings leaking or damaged?		Yes: Replace O-rings and reinstall original ECB1 (if undamaged). After repairs are complete, retest for original problem. No: Go to Step 5

Step 5	Determine if ECB1 actuator, or High-Pressure oil manifold have failed.	Decision
A. Install new ECB1 actuator B. After repairs are complete, retest for original problem. Is engine compression brake engaged when not commanded problem repaired?		Yes: End Diagnostic Steps No: Install a new high-pressure oil manifold. Adjust engine brake lash see *Engine Service Manual*. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Aftertreatment Symptoms

10.1 - Parked Regeneration Will Not Activate

Overview

Diagnose cause of parked aftertreatment regeneration is commanded ON, but aftertreatment regeneration does not start.

Possible Causes

- Power Take Off (PTO) / Auxilliary Engine Speed Control (AESC) active
- Accelerator off idle
- Clutch engaged
- Engine not warmed up (Engine Coolant Temperature 1 (ECT1) below 122°F [50° C])
- Regeneration inhibit switch enabled
- Service brake active
- System fault active
- Vehicle speed 5 MPH or more

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 10.0 Aftertreatment Operational Checkout Procedure?		Yes: Go to Step 2 (page 131).
		No: Go to 10.0 Aftertreatment Operational Checkout Procedure (page 42).

Step 2	Check for Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check for active DTCs. Does EST DTC list have any active SPN (other than DPF soot load SPN 3251, 3719 or 3936)? Do **NOT** diagnose DPF soot load faults at this time.		Yes: Go to Fault Code Diagnostics for appropriate SPN.
		No: Go to Step 3 (page 131).

Step 3	Verify all operator controls are set properly to allow parked regeneration.	Decision
Verify the following are true: • Power Take-Off (PTO) / Auxiliary Engine Speed Control (AESC) is not active • Accelerator pedal is not depressed • Clutch pedal is released • Engine is warmed up – ECT1 is above 122°F (50° C) • Regeneration inhibit switch is not enabled • Service brake is not depressed • Vehicle speed is less than 5 MPH Are all the above conditions true?		Yes: Go to Step 4 (page 132). No: Bring all operator controls to proper condition to allow a parked regeneration. After repairs are complete, retest for original problem.

Step 4	Use Electronic Service Tool (EST) to determine if parked regeneration is inhibited.	Decision
A. Connect EST with ServiceMaxx™ and log in. B. Select > Procedures > KOER Aftertreatment Procedures > DPF Regeneration. C. Select Inhibitors tab Are any Inhibitors listed as “inhibited”?		Yes: Repair component or circuit causing Inhibitor to be “inhibited”. After repairs are complete, retest for original problem. No: Go to Step 5 (page 132).

Step 5	Verify Electronic Control Module (ECM) is receiving signal to start parked regeneration.	Decision
A. Press Parked Regen Switch. B. Using EST with ServiceMaxx™ C. Select > Procedure > KOER Aftertreatment Procedures > System State tab > Regen Status sub tab. Is the AFT DPF Regen Stage active?		Yes: Verify each step was completed correctly No: Repair Force Regen Switch or circuit. After repairs are complete, retest for original problem.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify supervisor for further action.

10.2 - Black Smoke

Overview

Diagnose excessive black smoke comes out of exhaust.

Possible Causes

- Diesel Particulate Filter (DPF)
- Engine performance problem
- Injection Control Pressure (ICP)
- Injection Pressure Regulator (IPR)
- Exhaust leaks or damage

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 10.0 Aftertreatment Operational Checkout Procedure?		Yes: Go to
		No: Go to 10.0 Aftertreatment Operational Checkout Procedure (page 42).

Step 2	Check for engine performance related Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 931 Electric Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position (CMP) • SPN 637 Crankshaft Position (CKP) • SPN 27, 2791 Exhaust Gas Recirculation (EGR) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 175 Engine Oil Temperature (EOT) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 102 Intake Manifold Pressure (IMP) • SPN 132 Mass Air Flow (MAF) • SPN 651 - 656, 2797, 2798, 3055, 3659 - 3664, 4257 Injector (INJ) • SPN 105 Intake Manifold Temperature (IMT) Does ETC DTC list have any of the above listed SPN?		Yes: Go to Fault Code Diagnostics for appropriate SPN. No: Go to Step 3 (page 134).

Step 3	Test basic functionality of Diesel Particulate Filter (DPF).	Decision
Perform Snap Acceleration Test (page 2394). Is black smoke visible?		Yes: Go to Step 4 (page 134). No: Review operator complaint.

Step 4	Determine if DPF is reusable.	Decision
A. Remove and Inspect Diesel Particulate Filter (DPF) (see Exhaust Aftertreatment System with DPF and SCR Service Manual). B. Compare DPF to DOC and DPF Reuse Guidelines. Can the DPF be reused?		Yes: Install DPF. Go to Step 5 (page 134). No: Replace DPF. Go to Step 6 (page 135).

Step 5	Do DPF regeneration and check for exhaust leaks and damage.	Decision
Perform DPF Regeneration Procedure . While test is running, check the following components for exhaust leaks and verify all fasteners, brackets and clamps are secured and undamaged: • Low-Pressure (LP) turbocharger outlet pipe • Exhaust Back Pressure Valve (EBPV) • Flexible mesh pipe to the DOC inlet • Diesel Oxidation Catalyst (DOC) inlet Are all components free of exhaust leaks and all fasteners, brackets and clamps secure and undamaged?		Yes: Verify steps were completed correctly and the proper decision was made. No: Repair exhaust leaks, damage and loose parts. After repairs are complete, retest for original problem.

Step 6	Test for failed air management system actuator.	Decision
A. Perform Air Management Test (page 2175) while recording snapshot in ServiceMaxx™. B. When tests is complete, stop recording. C. Use playback feature in ServiceMaxx™ to graph the following signal values: • Mass Air Flow (MAF) mean • Intake Manifold Pressure (IMP) • Exhaust Gas Recirculation (EGR) valve position. Does snapshot closely match Air Management System Graph (GOOD) (page 2177)?		Yes: Go to Step 7 (page 135). No: Diagnose and repair failed actuator. After repairs are complete, retest for original problem.

Step 7	Check for Mass Air Flow (MAF) Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: • SPN 132 MAF Are SPN 132 faults present?		Yes: Go to Fault Code Diagnostics for appropriate SPN 132 fault. After repairs are complete, retest for original problem. No: Go to Step 8 (page 135).

Step 8	Inspect engine air intake (boost) leaks or restrictions.	Decision
A. Inspect air intake system from air filter to engine intake manifold for air leaks, damage or restrictions. B. Pressurize the Charge Air Cooler (CAC) system to 35 psi (241 kPa) using Charge Air Cooler (CAC) Tester ZTSE4341 and Interstage Cooler (ISC) Test Kit ZTSE4937. C. Inspect hoses and clamps, ISC and CAC Is the air intake system and CAC system free of restrictions, leaks or physical damage?		Yes: Perform 0 to 60 MPH Test (page 2236). Go to Step 9 (page 136). No: Repair air intake system leaks, damage or restrictions. After repairs are complete, retest for original problem.

Step 9	Determine if Injection Control Pressure (ICP) system is operating properly.	Decision
A. Using ServiceMaxx™ playback, graph the following signal values from the 0 to 60 MPH Test: • ICP Desired • ICP Actual • Injection Pressure Regulator (IPR) valve control % B. Look at snapshot and compare to 0 to 60 ICP/ICPD Graph (page 2240). Is ICP system operating similar to the 0 to 60 ICP/ICPD Graph?		Yes: Go to Step 10 (page 136). No: Diagnose and repair ICP system problem. After repairs are complete, retest for original problem.

Step 10	Review air management system operation during acceleration.	Decision
A. Using ServiceMaxx™ playback, graph the following signal values from 0 to 60 MPH Test: • Engine Speed • Engine Load • Intake Manifold Pressure (IMP) • Exhaust Back Pressure (EBP) • Accelerator Pedal Position 1 (APP1) B. Look at snapshot and reference 0 to 60 MPH RPM, Load, IMP, EBP and APP1 Graph (page 2242). Is air management system operating similar to 0 to 60 MPH RPM, Load, IMP, EBP and APP1 Graph?		Yes: Go to Step 11 (page 136). No: Diagnose and repair air management system problem. After repairs are complete, Go to Step 11 (page 136).

Step 11	Verify exhaust gas temperatures are within specifications.	Decision
A. Perform DPF Regeneration Procedure while recording a snapshot in ServiceMaxx™. B. When procedure is complete, stop recording C. Use playback feature in ServiceMaxx™ and graph the following signal values: • Diesel Oxidation Catalyst Inlet Temperature (DOCIT) • Diesel Particulate Filter Inlet Temperature (DPFIT) • Diesel Particulate Filter Outlet Temperature (DPFOT) D. Look at snapshot and reference Normal Exhaust Gas Temperature Graph (page 2245) and compare to Soot Load Level versus Exhaust Gas Target Temperature Chart (page 2406). Does snapshot closely match Normal Exhaust Gas Temperature Graph and does exhaust gas reach target temperature for soot load level?		Yes: Go to Step 12 (page 137). No, graph does not match: Go to Fault Code Diagnostics for failed DOCIT, DPFIT and/or DPFOT. After repairs are complete, retest for original problem. No, exhaust temperatures do not reach target temperature: Test and repair Engine Throttle Valve (ETV) and/or Exhaust Back Pressure Valve (EBPV). After Repairs are complete, retest for original problem.

Step 12	Repair any active faults set during DPF Regeneration.	Decision
Using EST with ServiceMaxx™, check DTC list for fault code(s) that may have become active during the DPF Regeneration Procedure. Does DTC List contain any active fault code(s)?		Yes: Go to Fault Code Diagnostics for appropriate fault. After repairs are complete, retest for original problem. No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify supervisor for further action.

10.3 - White Smoke

Overview

Diagnose cause of unburned diesel fuel or coolant passing into exhaust. Some white smoke is normal during engine warm-up.

Possible Causes

- Diesel Oxidation Catalyst (DOC)
- Exhaust Gas Recirculation (EGR) Cooler failure
- Injector fault
- Down Stream Injection (DSI) System (only if fault code sets)
- Low cylinder compression (rings, etc.)
- Air management system problems
- Intake air heater fault

Test Procedure

Step 1	Perform preliminary operational checkout procedure.	Decision
Did you perform 10.0 Aftertreatment Operational Checkout Procedure?		Yes: Go to Step 2 (page 138).
		No: Go to 10.0 Aftertreatment Operational Checkout Procedure (page 42).

Step 2	Determine if engine coolant is low, engine is overheating or has a history of either.	Decision
A. Review current Repair Order B. Review repair history using Navistar® Service Portal, enter Chassis/VIN Number Is engine coolant low, is engine overheating, or is there a history of either?		Yes: Go to 6.2 Coolant Loss (page 89), or 6.3 Coolant Over-Temp (page 91). After repairs are complete, retest for original problem.
		No: Go to Step 3 (page 138).

Step 3	Determine if engine has a performance problem.	Decision
Does vehicle have an engine performance problem (low power, misfire etc.)?		Yes: Go to 5.0 Engine Running, Engine Under Load Operational Checkout Procedure (page 36). After repairs are complete, retest for original problem.
		No: Go to Step 4 (page 139).

Step 4	Check for engine performance related Diagnostic Trouble Codes (DTC).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, check DTC list for: • SPN 91, 2623 Accelerator Pedal Position (APP) • SPN 94 Fuel Delivery Pressure (FDP) • SPN 102 Intake manifold Pressure (IMP) • SPN 105 Intake Manifold Temperature (IMT) • SPN 110, 1659 Engine Coolant Temperature 1 (ECT1) • SPN 111 Engine Warning and Protection System (EWPS) • SPN 175 Engine Oil Temperature (EOT) • SPN 931 Electronic Fuel Pump (EFP) • SPN 164, 3055 Injection Control Pressure (ICP) • SPN 679 Injection Pressure Regulator (IPR) • SPN 636 Camshaft Position Sensor (CMP) • SPN 637 Crankshaft Position Sensor (CKP) • SPN 132 Mass Air Flow (MAF) • SPN 2659 Air Management System (AMS) • SPN 27, 2791 Exhaust Gas recirculation (EGR) • SPN 1209 Exhaust Back Pressure (EBP) • SPN 3610 Diesel Particulate Filter Outlet Pressure (DPFOP) • SPN 5541, 5543 Exhaust Back Pressure Valve (EBPV) • SPN 3251 Diesel Particulate Filter Differential Pressure (DPFDP) • SPN 3471, 3479 Aftertreatment Fuel Doser (AFTFD) • SPN 3480 Aftertreatment Fuel Pressure 1 (AFTFP1) • SPN 3482 Aftertreatment Fuel Enable Control (AFTFEC) • SPN 3556, 4077 Aftertreatment Fuel Pressure 2 (AFTFP2) • SPN 5456 Aftertreatment Fuel Temperature (AFTFT)		Yes: Go to Fault Code Diagnostics for appropriate SPN. No: Go to Step 5 (page 140).

• SPN 51, 3464 Engine Throttle Valve (ETV) • SPN 651 - 656, 2797, 2798, 3055, 3659 - 3664, 4257 Injector (INJ) • SPN 729 Intake Air Heater Control (IAHC) Does EST DTC list have any of the above listed SPN?	

Step 5	Test Intake Air Heater (IAH) System.	Decision
Perform Intake Air Heater System Test (page 2283). Is IAH system operating properly and did all intake air heater Tests pass?		Yes: Go to Step 6 (page 140). No: Repair IAH Faults. After repairs are complete, retest for original problem.

Step 6	Test cooling system operation with engine at operating temperature.	Decision
A. Run engine to operating temperature B. Perform Cooling System Pressure Test (page 2314), Coolant Over-Flow / Over-Temperature Test (page 2318) and Thermostat Operational Test (page 2319). Is cooling system holding coolant under pressure, not overheating or overflowing?		Yes: Go to Step 7 (page 140). No: Repair coolant system problem. After repairs are complete, retest for original problem.

WARNING: To prevent injury or death, allow engine to cool before removing components.

WARNING: To prevent injury or death, provide proper ventilation when operating an engine in a closed area. Inhalation of exhaust gas can be fatal.

Step 7	Determine if base engine problem is causing white smoke.	Decision
A. Remove turbocharger down pipe. B. Run engine to operating temperature. C. Run engine at high idle for 10 seconds. Is thick white smoke clearly visible?		Yes: Repair base engine problem causing white smoke (EGR Cooler, cracked injector tip, failed power cylinder, etc.). After repairs are complete, retest for original problem. No: Go to Step 8 (page 140).

Step 8	Determine if DOC and DPF are operating properly.	Decision
Perform DPF Regeneration . Does Diesel Particulate Filter Outlet Temperature (DPFOT) exceed 1200° F (650° C)?		Yes: Remove and inspect DOC. Refer to “DOC and DPF Reuse Guidelines” in the Exhaust Aftertreatment System with DPF and SCR Service Manual. After repairs are complete, retest for original problem.
		No: End Diagnostic Steps.

End Diagnostic Steps
After performing all diagnostic steps, if fault remains, verify each step was completed correctly and the proper decision was made. Notify supervisor for further action.

Fault Code Diagnostics

Section Information

All electrical faults in the engine control system can be diagnosed in this section. All components are divided into separate test procedures and contain the following information:

- SPN / FMI with possible cause
- Circuit diagram
- Component function
- Circuit operation
- Component location
- Diagnostic tool list
- Sensor End Diagnostics (with ServiceMaxx™ software)
- Pin-point Diagnostics (without ServiceMaxx™ software)
- Step Based Diagnostics
- Harness resistance check
- Operational voltage check (most components)

AAT Sensor (Ambient Air Temperature)

Overview of AAT Sensor

SPN	FMI	Description
171	2	AAT Signal Erratic, Intermittent, or Incorrect (page 144)
171	3	AAT Signal Out of Range HIGH (page 146)
171	4	AAT Signal Out of Range LOW (page 152)

Overview

Ambient Air Temperature (AAT) measures outside air temperature where engine is operating. AAT represents air temperature for engine cooling performance.

SPN 171 FMI 2 - AAT Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of Ambient Air Temperature sensor to other engine temperature sensors after a calibrated adjustable cold-soak period (time).	Absolute difference between Ambient Air Temperature and Manifold Air Temperature > 59°F (15°C) AND Absolute difference between Ambient Air Temperature and Charge Air Cooler Out Temperature > 59°F (15°C)	Key ON time < 500 seconds Temperature compensation based on engine coolant temperature and engine off timer of Table A156 Engine Off timer ≥ 28800 seconds OBD Global Monitoring is not disabled Absolute difference between Manifold Air Temperature and Charge Air Cooler Out Temperature < 59°F (15°C)

Fault Overview

ECM Compares Ambient Air Temperature (AAT) sensor other engine temperature sensors after a calibrated adjustable cold-soak period (time).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed wiring
- Failed AAT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 171 FMI 2. Is EST DTC list SPN 171 FMI 2 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Ambient Air Temperature (AAT) connector.	Decision
A. Key OFF. B. Disconnect AAT connector. C. Check AAT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AAT connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 171 FMI 2.

Step 3	Inspect connections at Ambient Air Temperature (AAT) connector.	Decision
A. Key OFF. B. Connect Breakout Harness ZTSE4993 between pin-1 and pin-2 on AAT connector. C. Key-On Engine-Off (KOEO). Using EST with ServiceMaxx™ software, measure voltage between pin-1 and pin-2. Is voltage less than 0.5 volts?		Yes: Replace AAT sensor. After repairs are complete, retest for SPN 171 FMI 2. No: Go to step 4.

Step 3	Inspect connections at Ambient Air Temperature (AAT) connector.	Decision
A. Key OFF. B. Connect Breakout Harness ZTSE4993 between pin-1 and known good GND. C. Key-On Engine-Off (KOEO). Using EST with ServiceMaxx™ software, measure resistance. Is resistance less than 5 ohms?		Yes: Repair AAT signal wire. After repairs are complete, retest for SPN 171 FMI 2. No: Repair AAT SIG GND wire. After repairs are complete, retest for SPN 171 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 171 FMI 2 fault code diagnostics.

SPN 171 FMI 3 - AAT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Ambient Air Temperature (AAT) value greater than expected.	AAT sensor voltage > 4.5 volts	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Ambient Air Temperature (AAT) voltage is greater than 4.5 volts for 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle

Continuous

Possible Causes

- AAT sensor signal circuit OPEN
- AAT sensor signal circuit short to PWR
- AAT sensor SIG GND circuit OPEN
- Failed AAT sensor

Step 1	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 171 FMI 3. Does EST DTC list show SPN 171 FMI 3 as active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Ambient Air Temperature (AAT) sensor.	Decision
A. Key-On Engine-Off (KOEO). B. Disconnect AAT harness connector. C. Check AAT and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are sensor connector, harness and terminals clean and undamaged?		Yes: Perform Pin-Point Test (SPN 171 FMI 3) . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 171 FMI 3.

Pin-Point Test (SPN 171 FMI 3)

AAT Circuit

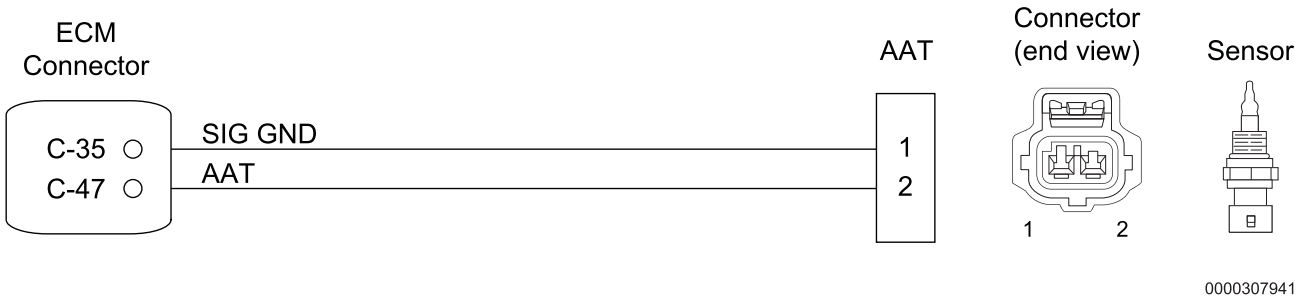


Figure 10 Ambient Air Temperature (AAT) Sensor Circuit Diagram

See the latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Tools Required

- Breakout Harness ZTSE4871
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

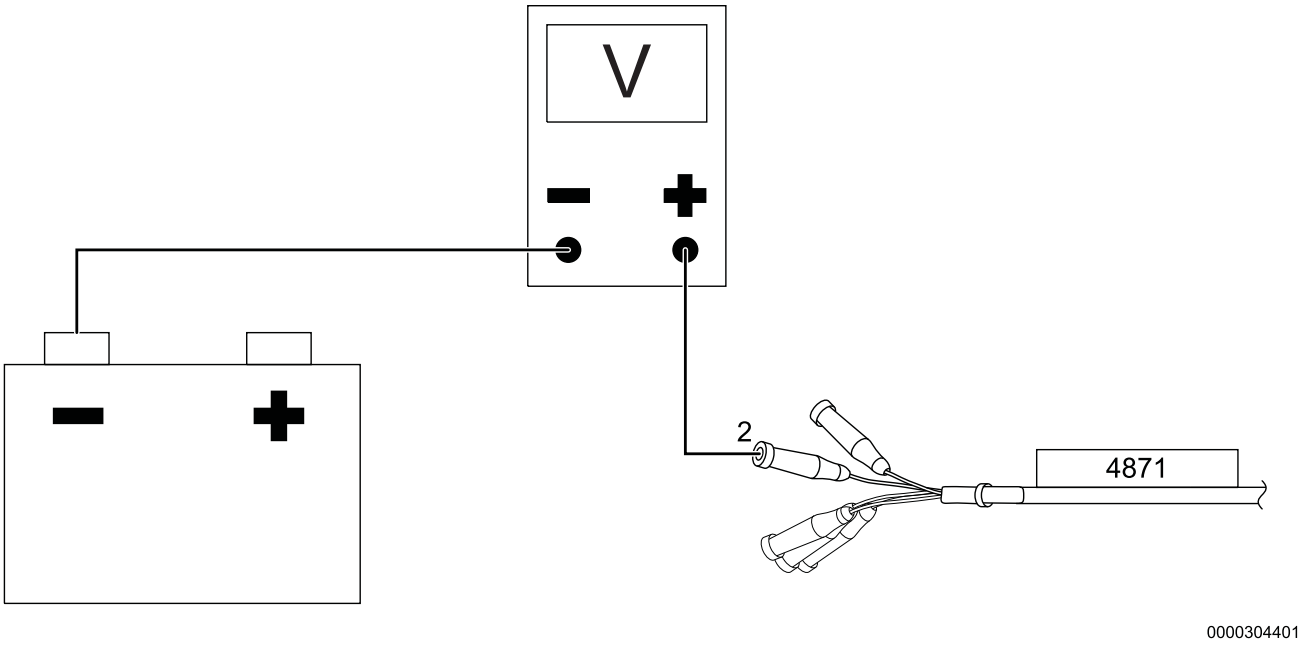
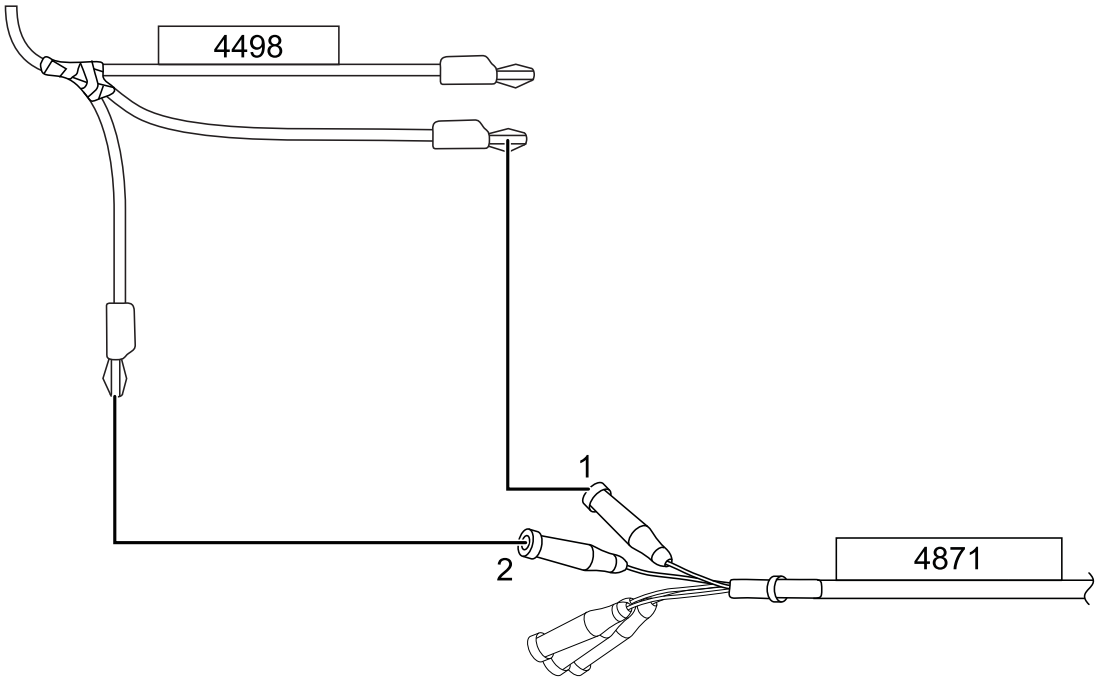


Figure 11 Test 1 AAT sensor circuit check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4871 to AAT vehicle harness and leave AAT sensor disconnected. C. Key ON.

Test 1 AAT Circuit Voltage Check for Short to PWR	Specification
Use Digital Multimeter (DMM) to measure voltage between Breakout Harness ZTSE 4871 pin-2 and a known good GND.	Greater than 6 volts
Decision	
Is voltage greater than 6.0 volts?	Yes: Repair short to PWR between AAT pin-2 and Engine Control Module (ECM) 76-Pin pin C-47. After repairs are complete, retest for SPN 171 FMI 3.
	No: Go to Test 2.



0000304403

Figure 12 Test 2 AAT sensor circuit check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4871 to AAT vehicle harness and leave AAT sensor disconnected. C. Using Breakout Harness ZTSE4498 short pin-1 and pin-2 of Breakout Harness ZTSE4871 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON, log into ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) fault list.	DTC list SPN 171 FMI 4 sets
Decision	
Does SPN 171 FMI 4 set after DTC list is cleared?	Yes: Replace AAT sensor. After repairs are complete, retest for SPN 171 FMI 3.
	No: Go to Test 3.

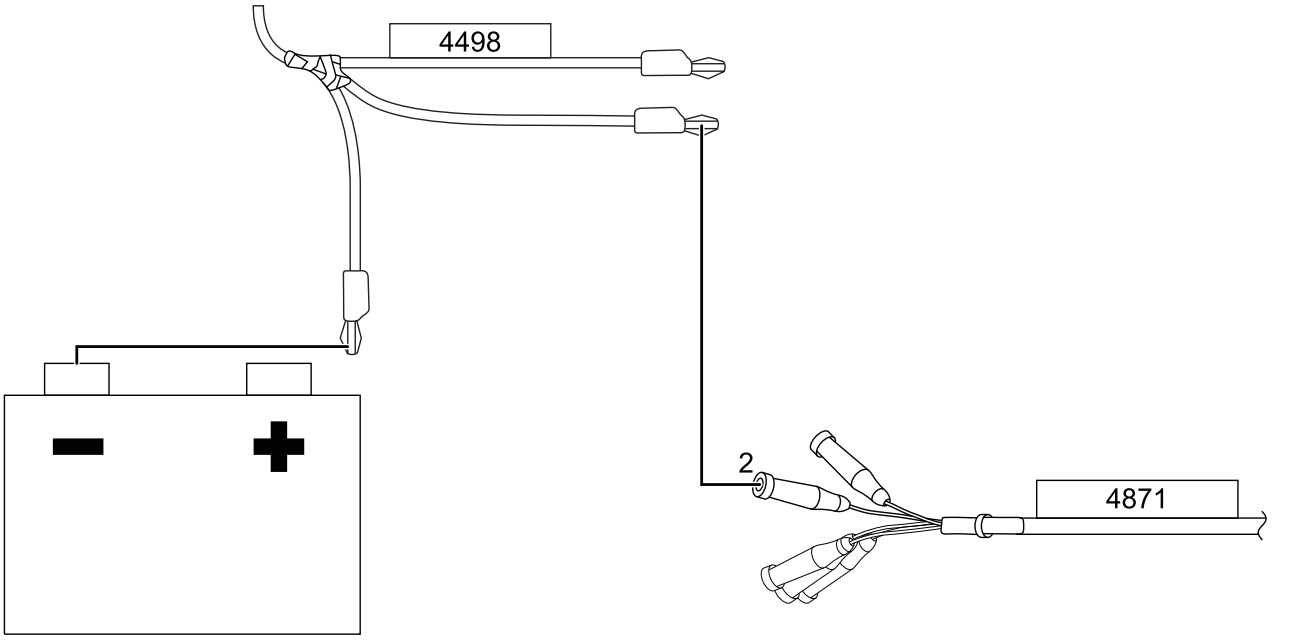


Figure 13 Test 3 AAT sensor circuit check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4871 to AAT vehicle harness and leave AAT sensor disconnected. C. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4871 pin-2 to GND. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector. E. Key ON, log in to ServiceMaxx™ software.

Test 3 Clear DTC fault list.	Specification
Using EST with ServiceMaxx™, clear DTC fault list.	SPN 171 FMI 4 sets in DTC list
Decision	
Does SPN 171 FMI 4 set after DTC list is cleared?	Yes: Repair Open between AAT sensor pin-1 and ECM pin C-35. After repairs are complete, retest for SPN 171 FMI 3.
	No: Repair Open between AAT sensor pin-2 and ECM pin C-47. After repairs are complete, retest for SPN 171 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 171 FMI 3 fault code diagnostics.

SPN 171 FMI 4 - AAT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Ambient Air Temperature (AAT) sensor reading is lower than expected.	AAT sensor voltage < 0.25 volt	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Ambient Air Temperature (AAT) signal voltage is lower than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when the fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Ambient Air Temperature (AAT) signal circuit short to GND
- Failed AAT sensor

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 171 FMI 4. Does EST DTC list show SPN 171 FMI 4 as active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Ambient Air Temperature (AAT) sensor module connector.	Decision
A. Key OFF. B. Disconnect Ambient Air Temperature (AAT) sensor module connector. C. Check AAT sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the AAT sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 171 FMI 4.

Pin-Point Tests (SPN 171 FMI 4)

AAT Circuit



Figure 14 Ambient Air Temperature (AAT) Sensor Circuit Diagram

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

See the latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Ambient Air Temperature (AAT) sensor harness connector and leave sensor disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 171 FMI 3 sets
Decision	
Does SPN 171 FMI 3 set after DTC is cleared?	Yes: Replace AAT sensor. After repairs are complete, retest for SPN 171 FMI 4.
	No: Repair short to GND between AAT sensor pin-2 and Engine Control Module (ECM) pin C-47. After repairs are complete, retest for SPN 171 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 171 FMI 4 fault code diagnostics.

AFT (Aftertreatment) System

Overview of AFT System Group

SPN	FMI	Description
3251	0	DPFDP excessively HIGH (Plugged filter) (page 158)
3251	15	DPF Soot Load - Least Severe Level (page 160)
3251	16	DPF Soot Load - Moderately Severe Level (page 162)
3695	2	DPF Regen Inhibit Switch erratic, intermittent or incorrect (page 164)
3695	19	DPF Regen Inhibit Switch status not detected on J1939 (page 166)
3703	31	DPF Active Regeneration Inhibited Due to Inhibit Switch (page 168)
3713	31	DPF Active Regeneration Inhibited Due to System Timeout (page 170)
3719	0	DPF Soot Load - Highest (level 3/3) (page 172)
3719	15	DPF Soot Load - Lowest (level 1/3) (page 174)
3719	16	DPF Soot Load - Moderate (level 2/3) (page 176)
3750	31	DPF Regen inhibited due to low exhaust temperatures (page 178)
3936	14	DOC/DPF Temperature module (Incorrect Part) (page 180)
3936	15	DPF System above Warning Pressure (page 182)
3936	16	DPF System above Maximum Pressure (page 186)
4795	31	DPFDP excessively LOW (sensor/circuit fault or missing DPF) (page 190)
4796	31	Diesel Oxidation Catalyst Missing (page 192)
5298	17	DOC Efficiency fault, Temperature below minimum Regen Aborted (page 195)
5298	18	DOC Efficiency fault, Temperature below minimum (page 198)
5319	31	DPF incomplete Regeneration (page 200)

Overview

Aftertreatment (AFT) System catalyzes carbon monoxide (CO), Oxides of Nitrogen (NOx), and Hydrocarbons (HC), and has three main components: Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF), decomposition reactor tube, and Selective Catalyst Reduction (SCR) catalyst.

DPF captures soot and other particulates exiting engine. Typically good running engine will have 99% soot to 1% ash.

Soot is captured by DPF. Although DOC should not require regular maintenance, DPF does require occasional off-board cleaning to remove ash.

Soot is converted to carbon dioxide by a process of regeneration (Regen). Temperature at face of DPF is raised to approximately 1000°F (538°C), for a period of time, depending on amount of soot that accumulated within DPF. Regen time is calculated by the DPF Differential Pressure (DPFDP) feedback.

Regen may take place as vehicle is in operation under steady state heavy engine loading condition, or by commanding Parked Regen.

During Parked Regen, engine speed is increased, while Engine Control Module (ECM) controls Post-Injection, Exhaust Gas Recirculation (EGR), and Engine Throttle Valve (ETV) to increase heat going into exhaust system. Intake Air Heater (IAH) may also cycle on and off, not just to increase Intake Air Temperature (IAT), but to add extra load on engine.

Health of system and Regen processes are monitored by DOC Intake Temperature (DOCIT), DPF Intake Temperature (DPFIT), DPF Outlet Temperature (DPFOT), and Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor. DPFDP / DPFOP sensor measures pressure difference across DPF. DOCIT, DPFIT, and DPFOT sensors measure temperature differences across DOC and DPF and are part of DOC / DPF temperature sensor module.

DPF and / or DOC may fail or become restricted prematurely for a number of reasons. It is important to pinpoint root cause and repair failure before replacing DOC or DPF. Failure to do so could result in destroying a newly replaced component.

Any time DPF is replaced or removed for cleaning, record DPF serial number and use ServiceMaxx™ software to run Diesel Particulate Filter Servicing procedure. Follow on-screen instructions. See DPF Servicing in "DIAGNOSTIC SOFTWARE OPERATION" for additional information.

Aftertreatment system reduces NOx by injecting Diesel Exhaust Fluid (DEF) through Diesel Exhaust Fluid Doser Unit (DEF: DU), and into decomposition reactor tube. Exhaust heat in decomposition reactor tube causes DEF to break down and convert to ammonia and CO_2.

Final component of aftertreatment system is SCR catalyst. SCR catalyst completes break down of DEF into ammonia and CO_2, and then converts ammonia and NOx into Nitrogen gas and water.

SPN 3251 FMI 0 - DPFDP excessively HIGH (Plugged filter)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN / FMI: 3246/20, 3251/2, 3251/21, 3556/0, 3556/1, 3556/7, 3719/0, 3719/15, 3719/16, 3936/0, 3936/2, and 3936/14

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted or plugged filter
- Biased Diesel Particulate Filter Differential Pressure (DPFDP) sensor or circuit
- Reversed DPF sensor hoses

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3695 FMI 19 (J1939). Is EST DTC list free of SPN 3695 FMI 19?		Yes: Go to Step 2. No: Repair SPN 3695 FMI 19. After repairs are complete, retest for SPN 3695 FMI 2.

Step 2	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3695 FMI 19 (J1939). Is EST DTC list free of SPN 3695 FMI 19?		Yes: Go to Step 2. No: Repair SPN 3695 FMI 19. After repairs are complete, retest for SPN 3695 FMI 2.

Step 2	Check for correct DPF regen inhibit switch position.	Decision
Verify DPF regen inhibit switch is in correct position. Is DPF regen inhibit switch OFF, allowing for active regenerations of aftertreatment system?		Yes: Replace DPF regen inhibit switch. After repairs are complete, retest for SPN 3695 FMI 2. No: Turn DPF regen inhibit switch OFF. After repairs are complete, retest for SPN 3695 FMI 2.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3695 FMI 2 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3251 FMI 15 - DPF Soot Load - Least Severe Level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3251 FMI 16 - DPF Soot Load - Moderately Severe Level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3695 FMI 2- DPF Regen Inhibit Switch erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Active regeneration of the aftertreatment system is inhibited due to Diesel Particulate Filter (DPF) regen inhibit switch left in ON position.	Active regeneration needed and DPF regen inhibit switch active	DPF regen inhibit switch ON Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter (DPF) regen inhibit switch is On, and active regeneration of aftertreatment system is needed.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

SPN 3695 FMI 19 (J1939)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Diesel Particulate Filter (DPF) regen inhibit switch ON
- Failed DPF regen inhibit switch

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3695 FMI 19 (J1939). Is EST DTC list free of SPN 3695 FMI 19?		Yes: Go to Step 2. No: Repair SPN 3695 FMI 19. After repairs are complete, retest for SPN 3695 FMI 2.

Step 2	Check for correct DPF regen inhibit switch position.	Decision
Verify DPF regen inhibit switch is in correct position. Is DPF regen inhibit switch OFF, allowing for active regenerations of aftertreatment system?		Yes: Replace DPF regen inhibit switch. After repairs are complete, retest for SPN 3695 FMI 2. No: Turn DPF regen inhibit switch OFF. After repairs are complete, retest for SPN 3695 FMI 2.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3695 FMI 2 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3695 FMI 19 - DPF Regen Inhibit Switch status not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter (DPF) regen inhibit switch status is not detected.	DPF regen inhibit switch status not detected on J1939	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) does not receive a message for status of Diesel Particulate Filter (DPF) regen inhibit switch over J1939 bus.

Lamp Reaction

This fault does not illuminate any lamp.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed or missing DPF regen inhibit switch
- Incorrectly programmed ACM

Step 1	Verify presence of DPF regen inhibit switch.	Decision
Verify truck is equipped with DPF regen inhibit switch. Is vehicle equipped with DPF regen inhibit switch?		Yes: Repair DPF regen inhibit switch fault (See appropriate Truck Electrical Circuit Diagrams). After repairs are complete, retest for SPN 3695 FMI 19.
		No: Verify ACM is not programmed for DPF regen inhibit switch. After repairs are complete, retest for SPN 3695 FMI 19.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3695 FMI 19 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3703 FMI 31 - DPF Active Regeneration Inhibited Due to Inhibit Switch

Condition / Description	Setting Criteria	Enable Conditions / Values
Active regeneration of aftertreatment system inhibited due to Diesel Particulate Filter (DPF) regen inhibit switch.	SPN 3719 FMI 0, 15, or 16 active or active regeneration requested while regen inhibit switch is enabled	Key-On Engine-Running (KOER) Regen inhibit switch enabled

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects regeneration (regen) inhibit switch is enabled when any of following occur: SPN 3719 FMI 0, 15, or 16 (DPF soot load) is active; or Active regeneration of aftertreatment system is needed.

Lamp Reaction

This fault does not illuminate any lamps.

Associated Faults

SPN 3695 FMI 2 and 19 (regen inhibit switch)

Fault Facts

This fault can indicate reason high soot load faults have been logged.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Regen inhibit switch enabled when active regeneration is needed.

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3695 FMI 2 and 19 (regen inhibit switch). Is EST DTC list free of SPN 3695 FMI 2 and 19?		Yes: Go to Step 2. No: Repair SPN 3695 FMI 2 and 19. After repairs are complete, retest for SPN 3703 FMI 31.

Step 2	Check for correct Diesel Particulate Filter (DPF) regen inhibit switch position.	Decision
Verify DPF regen inhibit switch is in correct position. Is DPF regen inhibit switch disabled allowing for active regenerations of aftertreatment system?		Yes: Run parked regen of aftertreatment system. After parked regen is performed, retest for SPN 3703 FMI 31. No: Disable regen inhibit switch and perform a parked regen of aftertreatment system. After parked regen is performed, retest for SPN 3703 FMI 31.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3703 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3713 FMI 31 - DPF Active Regeneration Inhibited Due to System Timeout

Condition / Description	Setting Criteria	Enable Conditions / Values
Active regeneration of aftertreatment system is needed, but fault that inhibits regeneration is present.	Regen inhibit fault present	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects active regeneration is needed, but fault that inhibits regeneration is present.

Lamp Reaction

None

Associated Faults

• SPN 3242 FMI 0, 2, 3, 4, 15, 16 (DPFIT)	• SPN 3246 FMI 0, 2, 3, 4, 15, 16 (DPFOT)	• SPN 3251 FMI 2, 3, 4 (DPFDP)	• SPN 3480 FMI 3, 4, (AFT: FP1) and (AFT: FT)
• SPN 3482 FMI 3, 4, (AFT: FPC)	• SPN 3556 FMI 0, 1, 7 (AFT: FP2)	• SPN 3610 FMI 2, 3, 4 (DPFDP)	• SPN 3695 FMI 2, 19 (DPF)
• SPN 3703 FMI 31 (AFT)	• SPN 3719 FMI 0, 15, 16 (AFT)	• SPN 3750 FMI 31 (AFT)	• SPN 3936 FMI 0, 14, 15 (DPF System)
• SPN 4360 FMI 2 (SCRIT)	• SPN 4765 FMI 2, 3, 4, 16 (DOCIT)	• SPN 4792 FMI 14 (AFT)	• SPN 4794 FMI 31 (AFT)
• SPN 4795 FMI 31 (AFT)	• SPN 4796 FMI 31 (AFT)	• SPN 5298 FMI 17, 18 (AFT)	• SPN 5397 FMI 31 (AFT)
• SPN 5742 FMI 11, 16 (DOC / DPF Temperature Sensor Module)	• SPN 5743 FMI 11, 16 (SCR Temp sensor module)		

Drive Cycle to Determine Fault Status

Continuous

Fault Fact

This fault can indicate the reason high soot load faults have been logged.

Possible Causes

- Regen inhibit faults present when active regeneration is needed.

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 170). Is EST DTC list free of Associated Faults?		Yes: Run a parked regeneration of the aftertreatment system, and retest for SPN 3713 FMI 31.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3713 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3713 FMI 31 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3719 FMI 0: DPF Soot Load - Highest (level 3/3)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3719 FMI 15 DPF Soot Load - Lowest (level 1/3)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3719 FMI 16 - DPF Soot Load - Moderate (level 2/3)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3750 FMI 31 - DPF Regen inhibited due to low exhaust temperatures

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Unable to begin closed loop control of active regeneration of Diesel Particulate Filter (DPF) due to low Diesel Oxidation Catalyst (DOC) temperature.	Diesel Particulate Filter Inlet Temperature (DPFIT) < 500°F (260°C).	Engine speed > 800 RPM for 200 seconds Barometric Pressure (BARO) ≥ 10.9 psi (75 kPa) Ambient Air Temperature (AAT) ≥ -4°F (-20°C) Active regeneration of DPF has been requested more than 200 seconds. Inactive: SPN 3242 FMI 3 and 4; SPN 4765 FMI 3 and 4; SPN 5742 FMI 3 and 4.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) is unable to achieve closed loop control of active regeneration of Diesel Particulate Filter (DPF) due to low Diesel Oxidation Catalyst (DOC) temperature.

Lamp Reaction

This fault does not illuminate the MIL when active.

Associated Faults

SPN 27 (EGR); SPN 51 (ETV); SPN 2659 (AMS); SPN 2791 (EGR); SPN 3058 FMI 10 (EGR System Monitor); SPN 3251 FMI 2, 3, and 4 (DPFDP);SPN 3242 (DPFIT); SPN 3246 (DPFOT); and SPN 4796 FMI 31 (DOC).

Fault Facts

This fault code may indicate exhaust temperature is not high enough to actively regenerate aftertreatment system. Driving vehicle with long-term increased load may increase exhaust temperatures and decrease aftertreatment regeneration frequency.

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Degraded Diesel Oxidation Catalyst (DOC)
- Exhaust leak
- Damaged or missing Diesel Particulate Filter (DPF)
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 27 (EGR); SPN 51 (ETV); SPN 2659 (AMS); SPN 2791 (EGR); SPN 3058 FMI 10 (EGR System Monitor); SPN 3251 FMI 2, 3, and 4 (DPFDP); SPN 3242 (DPFIT); SPN 3246 (DPFOT); and SPN 4796 FMI 31 (DOC). Is EST DTC list free of SPN 27; SPN 51; SPN 2659; SPN 2791; SPN 3058 FMI 10; SPN 3251 FMI 2, 3, and 4; SPN 3242; SPN 3246; and SPN 4796 FMI 31?		Yes: Go to Step 2. No: Repair SPN 27; SPN 51; SPN 2659; SPN 2791; SPN 3058 FMI 10; SPN 3251 FMI 2, 3, and 4; SPN 3242; SPN 3246; and SPN 4796 FMI 31. After repairs are complete, retest for SPN 3750 FMI 31.

Step 2	Exhaust system inspection.	Decision
Inspect exhaust system(page 2368) for leaks and physical damage. Is exhaust system free of leaks and physical damage?		Yes: Go to Step 3. No: Repair or replace leaking or damaged exhaust components. After repairs are complete, retest for SPN 3750 FMI 31.

Step 3	Check accuracy of aftertreatment temperature sensors.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT), Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) temperatures. Is DOCIT, DPFIT, and DPFOT temperatures within 77°F (25°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3750 FMI 31.

Step 4		Decision
Check the exhaust system for an installed and undamaged Diesel Particulate Filter (DPF). Is a DPF installed in the exhaust system and free damage?		Yes: Inspect DOC for damage and replace if damaged. After repairs are complete, retest for SPN 3750 FMI 31. No: Install correct DPF. After repairs are complete, retest for SPN 3750 FMI 31.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3750 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3936 FMI 14 - DOC / DPF Temperature module (Incorrect Part)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Calibration mismatch between DOC / DPF Temperature sensor module and Aftertreatment Control Module (ACM).	The device number requested by the Engine Control Module, to obtain the Aftertreatment ID for the Particulate Filter System Exhaust Gas Temperature Sensor, was returned as incorrect. OR Actual Aftertreatment ID received from the PFS EGTS Module does not match the expected PFS	Key ON 30,000 seconds since new DPF is installed.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Oxidation Catalyst / Diesel Particulate Filter (DOC / DPF) temperature sensor module part number does not match what is stored in the ACM.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

This fault is generally caused by having incorrect part number DOC / DPF Temperature Sensor Module installed. This fault may rarely be caused by calibration or CAN communication issues. If part number is correct, verify ACM and ECM have proper calibration installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Incorrect Diesel Oxidation Catalyst / Diesel Particulate Filter (DOC / DPF) temperature sensor module installed

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3936 FMI 14. Is EST DTC list SPN 3936 FMI 14 active or pending?		Yes: Install correct Diesel Oxidation Catalyst / Diesel Particulate Filter (DOC / DPF) temperature sensor module. After repairs are complete, retest for SPN 3936 FMI 14.
		No: Clear codes and retest for SPN 3936 FMI 14.

End Diagnostic Steps
After performing diagnostic step if SPN 3936 FMI 14 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3936 FMI 15 - DPF System above Warning Pressure

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DPF Differential Pressure / Outlet Pressure sensor signal in range, but above normal (least severe level).	DPF Differential Pressure / Outlet Pressure sensor has exceeded recommended limits.	Key-On Engine-Running (KOER). Engine Speed > 500 rpm. Inactive: SPN 3251 FMI 2, 3, and 4.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects soot load of Diesel Particulate Filter (DPF) has exceeded maximum operating limits. Exhaust Gas Recirculation (EGR) valve will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 94 (FDP); SPN 102 (IMP); SPN 157 (FRP); SPN 651-656 (INJ / CYL); SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3246 2, 3, and 4 (DPFOT); SPN 3251 FMI 2, 3, and 4 (DPFDP / Outlet Pressure); SPN 4765 2, 3, and 4 (DOCIT); SPN 5541 (TC1TOP).

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test.

Possible Causes

- Engine performance problem
- Regen inhibited
- Restricted DPFDP hoses
- Engine mechanical fault
- Failed DPFDP sensor
- Failed fuel injector

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3246 2, 3, and 4 (DPFOT); SPN 3251 FMI 2, 3, and 4 (DPFDP / Outlet Pressure); SPN 4765 2, 3, and 4 (DOCIT). Is EST DTC list free of SPN 3242 FMI 2, 3, and 4; SPN 3246 2, 3, and 4; SPN 3251 FMI 2, 3, and 4; SPN 4765 2, 3, and 4?		Yes: Go to Step 2. No: Repair SPN 3242 FMI 2, 3, and 4; SPN 3246 2, 3, and 4; SPN 3251 FMI 2, 3, and 4; SPN 4765 2, 3, and 4. After repairs are complete, retest for SPN 3936 FMI 15.

Step 2	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 (FDP); SPN 102 (IMP); SPN 157 (FRP); SPN 651-656 (INJ / CYL); SPN 5541 (TC1TOP). Is EST DTC list free of SPN 94; SPN 102; SPN 157; SPN 651-656; SPN 5541?		Yes: Go to Step 3. No: Repair SPN 94; SPN 102; SPN 157; SPN 651-656; SPN 5541. After repairs are complete, retest for SPN 3936 FMI 15.

Step 3	Determine if a regen inhibitor is inhibiting regeneration of aftertreatment system.	Decision
Using EST with ServiceMaxx™ software, KOER Aftertreatment DPF Regeneration Procedure. Does DPF Filter Regeneration procedure run without any active Inhibitors?		Yes: Go to Step 4. No: Correct active regen inhibitors (and ServiceMaxx™ Aftertreatment DPF Filter Regeneration Inhibitors tab). After repairs are complete, retest for SPN 3936 FMI 15.

Step 4	Inspect connections at DPF Differential Pressure (DPFDP) / outlet pressure sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / outlet pressure sensor. C. Check DPFDP / outlet pressure sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / outlet pressure sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 5. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3936 FMI 15.

Step 5	Monitor DPFDP / outlet pressure sensor signal.	Decision
A. Key-On Engine-Off (KOEO). B. Using EST with ServiceMaxx™ software, load Signals sessions(page 2103) and monitor DPFDP. Is DPFDP below 0.5 psi? (normal operation)		Yes: Go to Step 7. No: Go to Step 6.

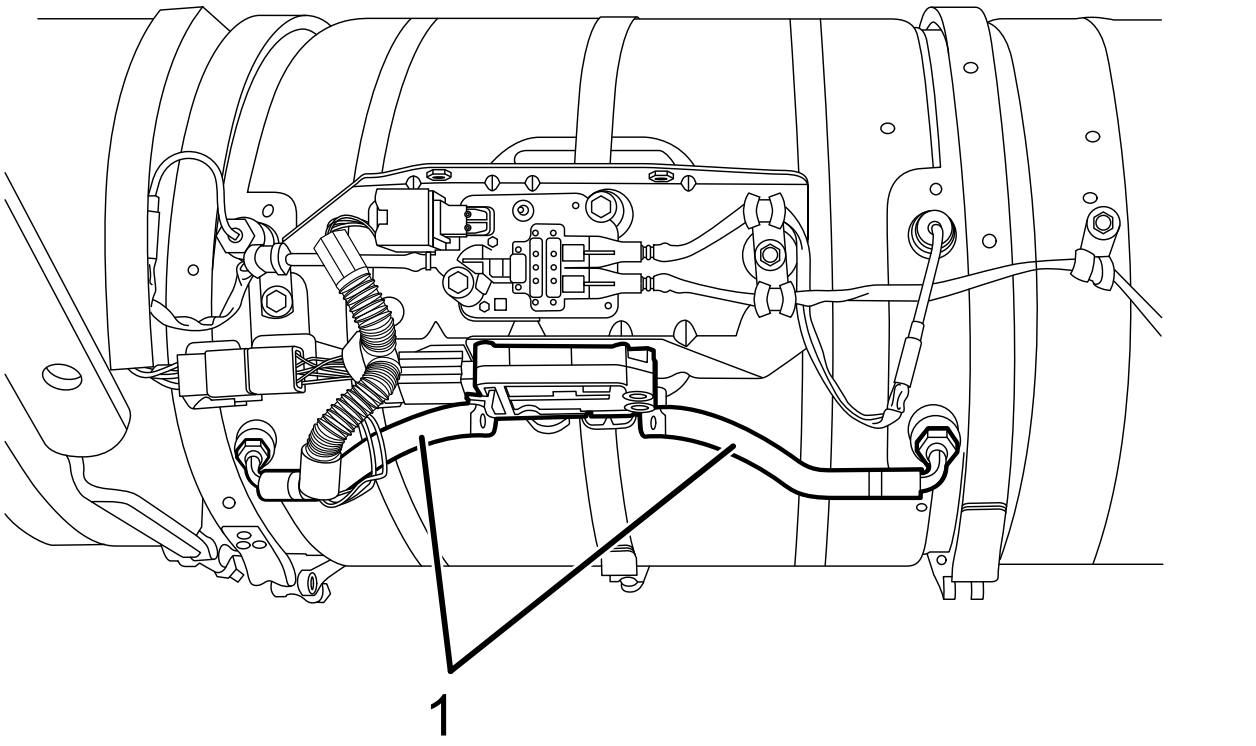


Figure 20 DPFDP Sensor and Hoses

1. DPFDP / outlet pressure hoses

Step 6	Check DPFDP sensor hoses for correct routing and restrictions.	Decision
Inspect the DPFDP sensor hoses for kinks, improper hose routing, restrictions, or damage. Are the DPFDP sensor hoses routed correctly, free of damage, and unrestricted?		Yes: Replace DPF Differential Pressure / Outlet Pressure sensor. After repairs are complete, retest for SPN 3936 FMI 15.
		No: Repair or replace DPFDP sensor hose(s). After repairs are complete, retest for SPN 3936 FMI 15.

Step 7	Determine if the engine has a mechanical cylinder balance problem (compression loss).	Decision
Perform Crankcase Pressure Test. Does engine have excessive crankcase pressure?		Yes: Repair base engine compression imbalance. After repairs are complete, retest for SPN 3936 FMI 15.
		No: Go to Step 8.

Step 8	Determine if engine has a fuel injector problem.	Decision
Perform Multiple Cylinder Cutout Test(page 2184). Did one or more cylinders have significant speed difference(s) than the others?		Yes: Go to Step 9. No: Go to Step 10.

Step 9	Inspect for failed valve train components.	Decision
Remove upper valve cover (see *Engine Service Manua*l). Inspect for bent valves, fallen bridges, and valves out of adjustment. Is valve train free of failed valve train components?		Yes: Replace injector suspected by Multiple Cylinder Cutout Test. After repairs are complete, retest for SPN 3936 FMI 15. No: Repair failed valve train components. After repairs are complete, retest for SPN 3936 FMI 15.

Step 10	Determine if vehicle has an engine performance related driveability problem.	Decision
Test drive the vehicle. Does engine have a performance problem?		Yes: Perform engine Performance Diagnostics(page 2140). After repairs are complete, retest for SPN 3936 FMI 15. No: Retest for SPN 3936 FMI 15.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3936 FMI 15 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3936 FMI 16 - DPF System above Maximum Pressure

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DPF System above Maximum Pressure	DPF Differential Pressure / Outlet Pressure sensor has exceeded recommended limits.	Key-On Engine-Running (KOER). Inactive: SPN 3251 FMI 2, 3, and 4.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects soot load of Diesel Particulate Filter (DPF) has exceeded maximum operating limits. Exhaust Gas Recirculation (EGR) valve will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 94 (FDP)	SPN 102 (IMP)	SPN 157 (FRP)	SPN 651-656 (INJ / CYL)
SPN 5541 (TC1TOP)	SPN 3242 FMI 2, 3, and 4 (DPFIT)	SPN 3246 2, 3, and 4 (DPFOT)	SPN 3251 FMI 2, 3, and 4 (DPFDP)
SPN 4765 2, 3, and 4 (DOCIT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test.

Possible Causes

- Engine performance problem
- Regen inhibited
- Restricted DPFDP hoses
- Engine mechanical fault
- Failed DPFDP sensor
- Failed fuel injector

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults (page 186). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3936 FMI 16.

Step 2	Determine if a regen inhibitor is inhibiting regeneration of aftertreatment system.	Decision
Using EST with ServiceMaxx™ software, KOER Aftertreatment DPF Regeneration Procedure. Does DPF Filter Regeneration procedure run without any active Inhibitors?		Yes: Go to Step 3. No: Correct active regen inhibitors (see ServiceMaxx™ Aftertreatment DPF Filter Regeneration Inhibitors tab). After repairs are complete, retest for SPN 3936 FMI 16.

Step 3	Inspect connections at DPF Differential Pressure (DPFDP) / outlet pressure sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / outlet pressure sensor. C. Check DPFDP / outlet pressure sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DPFDP / outlet pressure sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3936 FMI 16.

Step 4	Monitor DPFDP / outlet pressure sensor signal.	Decision
A. Key-On Engine-Off (KOEO). B. Using EST with ServiceMaxx™ software, load Signals sessions(page 2103) and monitor DPFDP. Is DPFDP below 0.5 psi? (normal operation)		Yes: Go to Step 6. No: Go to Step 5.

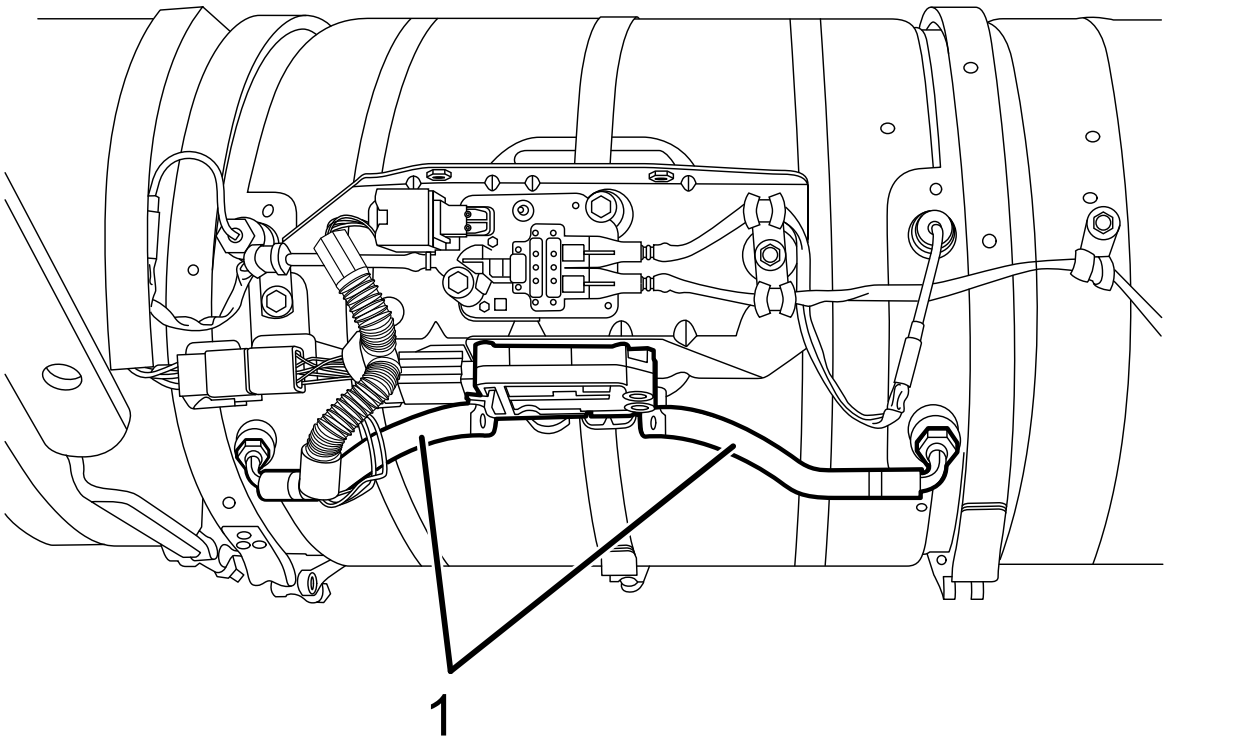


Figure 21 DPFDP Sensor and Hoses

1. DPFDP / outlet pressure hoses

Step 5	Check DPFDP sensor hoses for correct routing and restrictions.	Decision
Inspect the DPFDP sensor hoses for kinks, improper hose routing, restrictions, or damage. Are the DPFDP sensor hoses routed correctly, free of damage, and unrestricted?		Yes: Replace DPF Differential Pressure / Outlet Pressure sensor. After repairs are complete, retest for SPN 3936 FMI 16.
		No: Repair or replace DPFDP sensor hose(s). After repairs are complete, retest for SPN 3936 FMI 16.

Step 6	Determine if the engine has a mechanical cylinder balance problem (compression loss).	Decision
Perform Crankcase Pressure Test. Does engine have excessive crankcase pressure?		Yes: Repair base engine compression imbalance. After repairs are complete, retest for SPN 3936 FMI 16.
		No: Go to Step 8.

Step 7	Determine if engine has a fuel injector problem.	Decision
Perform Multiple Cylinder Cutout Test(page 2184). Did one or more cylinders have significant speed difference(s) than the others?		Yes: Go to Step 9. No: Go to Step 10.

Step 8	Inspect for failed valve train components.	Decision
Remove upper valve cover (see *Engine Service Manua*l). Inspect for bent valves, fallen bridges, and valves out of adjustment. Is valve train free of failed valve train components?		Yes: Replace injector suspected by Multiple Cylinder Cutout Test. After repairs are complete, retest for SPN 3936 FMI 16. No: Repair failed valve train components. After repairs are complete, retest for SPN 3936 FMI 16.

Step 9	Determine if vehicle has an engine performance related driveability problem.	Decision
Test drive the vehicle. Does engine have a performance problem?		Yes: Perform engine Performance Diagnostics(page 2140). After repairs are complete, retest for SPN 3936 FMI 16. No: Retest for SPN 3936 FMI 16.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3936 FMI 16 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4795 FMI 31 - DPFDP Excessively LOW (Sensor/Circuit Fault or Missing DPF)

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter (DPF) is not present in exhaust system.	Diesel Particulate Filter Differential Pressure (DPFDP) does not meet Aftertreatment Control Module (ACM) predetermined value	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Diesel Particulate Filter Differential Pressure (DPFDP) is below minimum value, and exhaust flow rate is above minimum flow rate. Active and parked regeneration of DPF will be disabled. The Exhaust Gas Recirculation (EGR) valve will be closed, and engine torque will be reduced if fault is active for extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3251 FMI 3 and 4 (DPFDP)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing DPF
- DPF damaged or failed
- DPFDP sensor hoses reversed or damaged

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3251 FMI 3 and 4 (DPFDP). Is EST DTC list free of SPN 3251 FMI 3 and 4?		Yes: Go to Step 2. No: Repair SPN 3251 FMI 3 and 4. After repairs are complete, retest for SPN 4795 FMI 31.

Step 2	Check the exhaust system for an installed DPF.	Decision
Is DPF installed in exhaust system?		Yes: Go to Step 3. No: Install proper DPF. After repairs are complete, retest for SPN 4795 FMI 31.

Step 3	Inspect Diesel Particulate Filter Differential Pressure (DPFDP) / Outlet Pressure (DPFOP) sensor hoses.	Decision
A. Key OFF. B. Inspect DPFDP / DPFOP sensor hoses for kinks, improper hose routing, reversed hoses, or damage. Are the DPFDP / DPFOP sensor hoses routed correctly and free of damage?		Yes: Inspect DPF for damage and replace as necessary. After repairs are complete, retest for SPN 4795 FMI 31. No: Reroute or replace DPFDP / DPFOP sensor hoses. After repairs are complete, retest for SPN 4795 FMI 31.

End Diagnostic Steps
After performing diagnostic step, if SPN 4795 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4796 FMI 31 - Diesel Oxidation Catalyst Missing

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Oxidation Catalyst (DOC) is not present in exhaust system.	Difference between Diesel Particulate Filter Intake Temperature (DPFIT) and Diesel Oxidation Catalyst Intake Temperature (DOCIT) < 95 °F (35°C)	The following fault codes must be inactive: SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3480 FMI 2, 3, 4, and 17 (AFT: FP1/AFT: FT); SPN 3482 FMI 2, 3, 4, and 7 (AFT: FSV); SPN 3490 FMI 3 and 4 (AFT: PAV); SPN 3556 FMI 2 and 5 (AFT); SPN 4765 FMI 2, 3, and 4 (DOCIT); SPN 5742 FMI 3, 4, 11, and 12 (DOC / DPF temperature sensor module) Exhaust flow rate of change < 200 g/sec Exhaust flow rate from 57.5 g/sec - 600 g/sec DPFIT ≥ 403°F (206°C) DOCIT ≥ 460°F (238°C) Rate of fuel injection into exhaust > 0.43 g/sec Rate of change of fuel injection into exhaust < 4.5 g/sec Elapsed time all enable conditions met ≥ 29.5 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor and Diesel Particulate Filter Intake Temperature (DPFIT) sensor are reading same temperature during an active regeneration for 80 seconds. Active and parked regeneration of Diesel Particulate Filter (DPF) will be disabled. Exhaust Gas Recirculation (EGR) valve will be closed, and engine torque will be reduced if fault is active for extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3242 FMI 2, 3, and 4 (DPFIT); and SPN 4765 FMI 2, 3, and 4 (DOCIT)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing Diesel Oxidation Catalyst (DOC)
- DOC damaged or failed

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3242 FMI 2, 3, and 4 (DPFIT); and SPN 4765 FMI 2, 3, and 4 (DOCIT). Is EST DTC list free of SPN 3242 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4?		Yes: Inspect DOC for damage and replace as necessary. After repairs are complete, retest for SPN 4796 FMI 31.
		No: Repair SPN 3242 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4. After repairs are complete, retest for SPN 4796 FMI 31.

End Diagnostic Steps
After performing diagnostic step, if SPN 4796 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5298 FMI 17 - DOC Efficiency fault, Temperature below minimum Regen Aborted

Condition / Description	Setting Criteria	Enable Conditions / Values
Active regeneration of Diesel Particulate Filter (DPF) aborted due to system detecting a malfunction with closed loop temperature controller, using up all of adjustment allowed.	Three occurrences of following condition during active regeneration of DPF, with each lasting for minimum of 60 seconds: • Desired Diesel Particulate Filter Intake Temperature (DPFIT) compared to actual DPFIT > 59 °F (15 °C) • Allowed Aftertreatment Fuel injection rate compared to desired rate greater than expected.	Key-On Engine-Running (KOER) Rate of active / intrusive injection of HC's into exhaust > 0.1 g/sec Ambient Air Temperature (AAT) > 19°F (-7°C) Inactive: SPN 3242 FMI 2, 3, and 4; SPN 3480 FMI 3, 4; SPN 3482 FMI 3, 4; SPN 4765 FMI 2, 3, and 4; SPN 5742 FMI 3, 4, 11, 16, and 19 (DOC / DPF)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects temperature differential across Diesel Oxidation Catalyst (DOC) during active regeneration of aftertreatment system is not matching expected temperature increase. Active and parked regeneration of DPF will be disabled. Exhaust Gas Recirculation (EGR) valve will be closed, and engine torque will be reduced if fault is active for extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3246 FMI 2, 3, and 4 (DPFOT); SPN 4765 FMI 2, 3, and 4 (DOCIT); SPN 5742 FMI 3, 4, 11, 16, and 19 (DOC / DPF)

Fault Facts

If aftertreatment system has had excess fuel, oil, coolant, metal, or other contamination; inspect engine and aftertreatment systems for cause of contamination before re-installing. Inspect for overheated aftertreatment components, cracked exhaust system welds, leaking exhaust system seams, or other damage.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Damaged or failed DOC
- Restricted DOC (soot accumulation)
- Exhaust system leak between turbocharger and DOC
- Failed Aftertreatment Fuel Injector (AFI)
- Failed Downstream Injection (DSI) system

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3246 FMI 2, 3, and 4 (DPFOT); and SPN 4765 FMI 2, 3, and 4 (DOCIT); SPN 5742 FMI 3, 4, 11, 16, and 19 (DOC / DPF). Is EST DTC list free of SPN 3242 FMI 2, 3, and 4; SPN 3246 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4; SPN 5742 FMI 3, 4, 11, 16, and 19?		Yes: Go to step 2. No: Repair SPN 3242 FMI 2, 3, and 4; SPN 3246 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4; SPN 5742 FMI 3, 4, 11, 16, and 19. After repairs are complete, retest for SPN 5298 FMI 17.

Step 2	Inspect exhaust system for leaks between turbocharger outlet and Diesel Oxidation Catalyst (DOC) intake.	Decision
A. Key-On Engine-Running (KOER). B. Check for cracked exhaust system welds, leaking exhaust system seams, or other damage. Is exhaust system sealed and undamaged?		Yes: Go to step 3. No: Repair or replace damaged exhaust system components. After repairs are complete, retest for SPN 5298 FMI 17.

Step 3	Inspect for a restricted or damaged DOC.	Decision
A. Remove the DOC (see appropriate *Exhaust System Service Manual*). B. Check DOC for restrictions from soot or oil contamination, cracks or damage to cells in DOC, and soot restrictions at front face of DOC. Is DOC unrestricted and free of damage?		Yes: Go to step 4. No: Clean or replace DOC. Refer to fault facts. After repairs are complete, retest for SPN 5298 FMI 17.



Figure 22 AFI Gaskets

1. New Aftertreatment Fuel Injector (AFI) gasket
2. Early production AFI gasket

Step 4	Perform visual inspection of Aftertreatment Fuel Injector (AFI).	Decision
Remove AFI housing from the turbocharger outlet pipe following procedures in the *Engine Service Manual* and perform the following visual checks: • Ensure correct AFI gasket (Figure 22) is installed. • Ensure AFI and bore are unrestricted and free of carbon buildup. • Ensure AFI tip is free of cracks and other damage Is AFI and bore unrestricted, free of carbon build up, and free of damage? Is the correct AFI gasket used?		Yes: Install AFI and go to Step 5. No: Repair all faults found during visual inspection. After repairs are complete, install AFI and go to Step 5.

Step 5	Perform the KOER DSI De-Aeration Procedure (page 2190).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, perform Procedures > KOER Aftertreatment Procedures > DSI System De-Aeration. Perform DSI System De-Aeration test twice. Does DSI System De-Aeration test procedure purge all air out of DSI system?		Yes: Diagnostics Complete. No: Repair DSI system. After repairs are complete, retest for SPN 5298 FMI 17.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5298 FMI 17 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5298 FMI 18 - DOC Efficiency fault, Temperature below minimum

Condition / Description	Setting Criteria	Enable Conditions / Values
Decrease in conversion capability of Diesel Oxidation Catalyst (DOC) that would cause tailpipe out emissions to exceed applicable On Board Diagnostics (OBD) threshold.	Filtered value of Hydrocarbon (HC) dosing efficiency < 57%, where HC dosing efficiency is defined as Diesel Oxidation Catalyst (DOC) Heat / DOC Dosing Heat	Key-On Engine-Running (KOER) Active regeneration running

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects temperature differential across Diesel Oxidation Catalyst (DOC) during active regeneration and does not indicate temperature increase for 225 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3242 FMI 2, 3, and 4 Diesel Particulate Filter Intake Temperature (DPFIT); SPN 3246 FMI 2, 3, and 4 Diesel Particulate Filter Outlet Temperature (DPFOT); and SPN 4765 FMI 2, 3, and 4 Diesel Oxidation Catalyst Intake Temperature (DOCIT)

Fault Facts

If aftertreatment system has had excess fuel, oil, coolant, metal, or other contamination; inspect the entire aftertreatment system for causal damage before re-installing. Inspect for overheated aftertreatment components, cracked exhaust system welds, leaking exhaust system seams, or other damage.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Damaged or failed DOC
- Restricted DOC (soot accumulation)
- Exhaust system leak between turbocharger and DOC

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3246 FMI 2, 3, and 4 (DPFOT); and SPN 4765 FMI 2, 3, and 4 (DOCIT). Is EST DTC list free of SPN 3242 FMI 2, 3, and 4; SPN 3246 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4?		Yes: Go to Step 2. No: Repair SPN 3242 FMI 2, 3, and 4; SPN 3246 FMI 2, 3, and 4; and SPN 4765 FMI 2, 3, and 4. After repairs are complete, retest for SPN 5298 FMI 18.

Step 2	Inspect exhaust system for leaks	Decision
Inspect exhaust system for leaks between turbocharger outlet and DOC intake. With Key-On Engine-Running (KOER), check for cracked exhaust system welds; leaking exhaust system seams; or other damage. Is exhaust system between turbocharger outlet and DOC intake sealed and undamaged?		Yes: Go to Step 3. No: Repair or replace damaged exhaust system components. After repairs are complete, retest for SPN 5298 FMI 18.

Step 3	Inspect DOC.	Decision
Remove the DOC (see Exhaust System in *Engine Service Manual*). Check DOC for restrictions from soot or oil contamination, cracks, or damage to cells in DOC, and soot restrictions at front face of DOC. Is DOC unrestricted and free of damage?		Yes: Go to Step 4. No: Clean or replace DOC. Refer to fault facts. After repairs are complete, retest for SPN 5298 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5298 FMI 18. remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5319 FMI 31 - DPF incomplete Regeneration

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter (DPF) Incomplete regeneration	Soot load (Aftertreatment 1 DPF differential pressure sensor based) after a "Successful Regeneration Event" > 95 hPa/m3	Particulate Filter Regeneration NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Battery Voltage ≥ 10.787 Volts AND ≥ 15.787 Volts Key ON Time after engine start ≥ 30 seconds Volumetric flow > 88000 g/hr (400000 liters/hr) SUM [{Aftertreatment # 1 DPF Inlet temperature * 0.2 and Aftertreatment # 1 DPF outlet temperature * 0.8} < 752°F (400°C) Estimated soot load < 60 hPa/m3 Number of failed regenerations < 10 regenerations SPN / FMIs 27/14, 102/10, 102/18, 108/3, 108/4, 132/0, 132/1, 132/3, 132/4, 2659/20, 2791/2, 2791/3, 2791/4, 2791/7, 2791/8, 2791/14, 3242/3, 3242/4, 3246/2, 3246/3, 3246/4, 3251/3, 3251/4, 3251/21, 3356/0, 3471/1, 3471/7, 3479/3, 3479/5, 3479/6, 3480/3, 3480/4, 3482/3, 3482/4, 3556/1, 3556/7, 3936/2, 3936/8, 3936/20, 4077/3, 4257/16, 4765/3, 4765/4, 4766/10, 5541/3, 5541/4, 5543/3, 5543/4, 5543/5 are NOT Active.

Fault Overview

Fault sets when the Engine Control Module (ECM) determines the pressure is to low in the DPF.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3251 FMI 2, 3, and 4.

Fault Facts

Excessive ash accumulation in Diesel Particulate Filter (DPF) will cause frequent regenerations of aftertreatment system. If all step-based diagnostics have been completed with no failure found, inspect ash load of the DPF.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Lube oil leak to exhaust
- Failed fuel injector
- Engine mechanical
- Failed Diesel Particulate Filter Differential Pressure (DPFDP) / outlet pressure sensor
- Restricted DPFDP / outlet pressure sensor hose(s)
- DPF restricted, damaged, or contaminated
- Diesel Oxidation Catalyst (DOC) restricted, damaged, or contaminated
- Miss-routed DPFDP hoses

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3251 FMI 2, 3, and 4. Is EST DTC list free of SPN 3251 FMI 2, 3, and 4?		Yes: Go to Step 2. No: Repair SPN 3251 FMI 2, 3, and 4. After repairs are complete, retest for SPN 5319 FMI 31.

Step 2	Inspect connections at Diesel Particulate Filter Differential Pressure (DPFDP) / outlet pressure sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / outlet pressure sensor. C. Check DPFDP / outlet pressure sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DPFDP / outlet pressure sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5319 FMI 31.

Step 3	Monitor DPFDP signal.	Decision
A. Key ON Engine Running (KOER). B. Using Electronic Service Tool (EST) with ServiceMaxx™ software, load Signals session and monitor DPFDP. C. Bring engine to high idle. Is DPFDP below 0.5 psi (3.45 kPa)?		Yes: Go to Step 5. No: Go to Step 4.

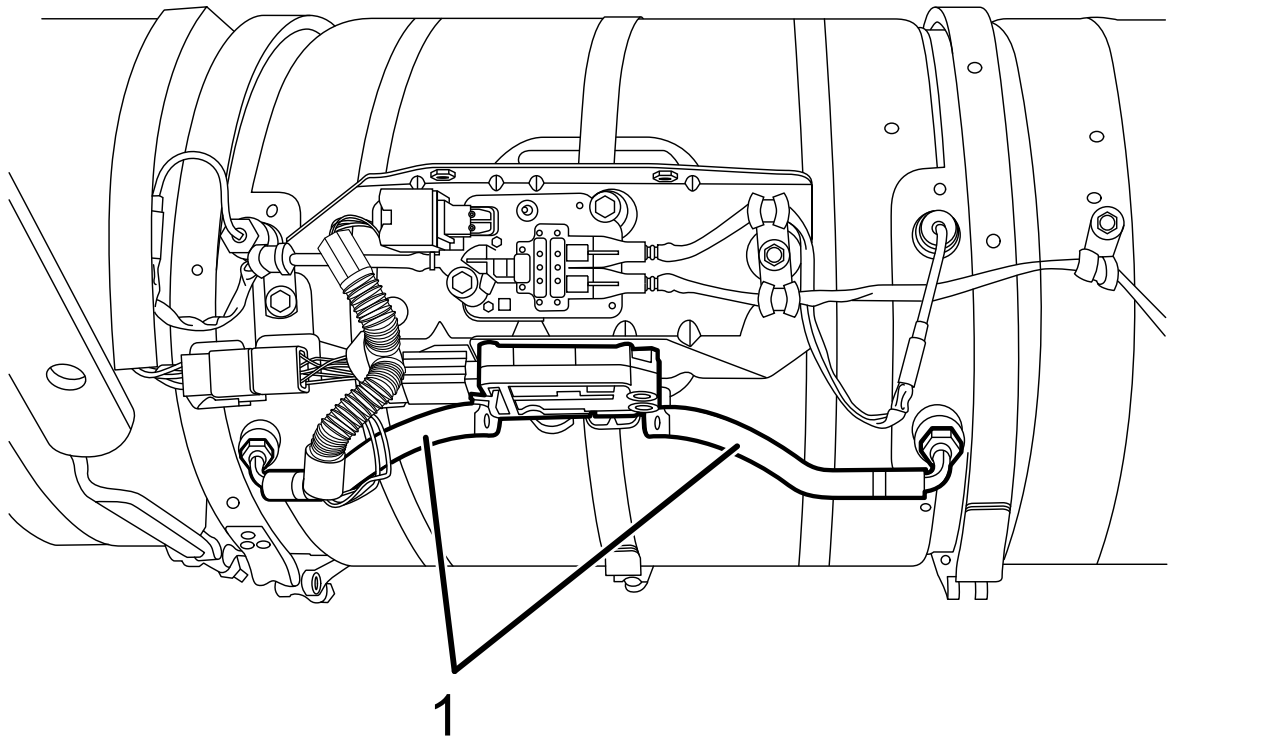


Figure 23 DPFDP Sensor Hose Routing

Step 4	Check DPFDP sensor hoses for correct routing and restrictions.	Decision
Inspect DPFDP sensor hoses for kinks, improper hose routing, restrictions, or damage. Are DPFDP sensor hoses routed correctly, free of damage, and unrestricted?		Yes: Replace DPF Differential Pressure / Outlet Pressure sensor. After repairs are complete, retest for SPN 5319 FMI 31.
		No: Repair or replace DPFDP sensor hose(s). After repairs are complete, retest for SPN 5319 FMI 31.

Step 5	Inspect for oil in the exhaust.	Decision
Perform Engine Oil to Exhaust(page 111) check. Was oil found leaking into exhaust?		Yes: Repair base engine fault. After repairs are complete, retest for SPN 5319 FMI 31.
		No: Go to Step 6.

Step 6	Check for failed fuel injector.	Decision
Perform Cylinder Performance Analyzer (CPA) Road Test(page 2217). Did CPA Road Test identify a cylinder misfire?		Yes: Check injector(s) on identified cylinder(s) and repair as necessary. After repairs are complete, retest for SPN 5319 FMI 31.
		No: Go to Step 7.

Step 7	Check for leaking Aftertreatment Fuel Injector (AFI).	Decision
Perform Key-On Engine-Running (KOER) Down Stream Injection (DSI) System Test(page 2187).		Yes: Repair leak in DSI system. After repairs are complete, retest for SPN 5319 FMI 31.
Was a leak identified by DSI leak test?		No: Go to Step 8.

Step 8	Check for restricted DPF.	Decision
Perform Diesel Particulate Filter (DPF) Inspection(page 2370). Was Diesel Particulate Filter (DPF) free of contamination, soot leakage, and filter damage, and DPF channels should be free of restrictions?		Yes: Clean or replace DPF. After repairs are complete, retest for SPN 5319 FMI 31.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 5319 FMI 31.

End Diagnostic Steps
After performing diagnostic steps, if SPN 5319 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

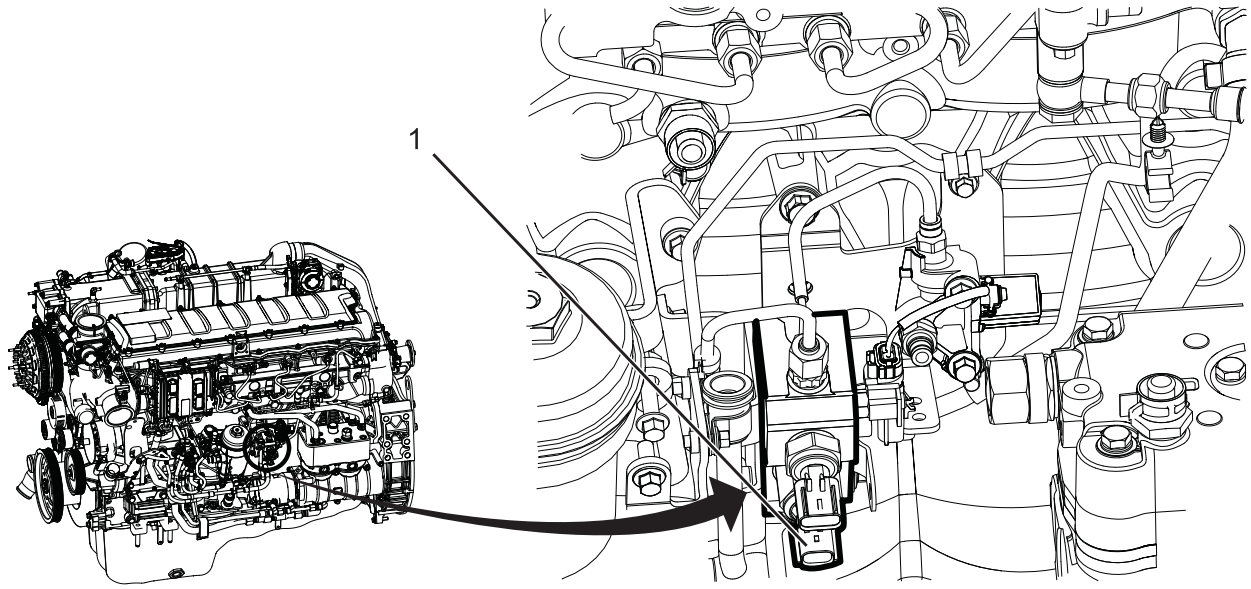
AFT: FEC (Aftertreatment Fuel Enable Control)

Overview of AFT: FEC Sensor Group

SPN	FMI	Description
3482	3	AFT Fuel Enable Control Valve short to PWR (page 206)
3482	4	AFT Fuel Enable Control Valve open or short to GND (page 216)

Overview

Aftertreatment Fuel Enable Control (AFT: FEC) controls the fuel supply to the Aftertreatment Fuel Pressure Control (AFT: FPC) when regeneration is required. The AFT: FEC is controlled by the Doser Control Unit (DCU).



0000058136

Figure 24 AFT: FEC Sensor Location

1. AFT: FEC

SPN 3482 FMI 3 - AFT Fuel Enable Control Valve short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment 1 Fuel Enable Actuator Short to Power.	High Side Circuit Current > 8.82 Amps Low Side Circuit Current > 8.82 Amps	Key ON Whenever Energized Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault Code sets when Doser Control Unit (DCU) Module detects signal from Aftertreatment Fuel Enable Control (AFT: FEC) is greater than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

DCU deactivates circuits when a circuit fault is present, so NOID lamp is needed to simulate correct circuit. Fault is latched for a key cycle, so ECM must be reset by a Key-Off cycle

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FEC-H circuit Open or high resistance
- AFT: FEC-L circuit Open or high resistance
- AFT: FEC-H circuit short to GND
- AFT: FEC-L circuit short to GND
- Failed AFT: FEC

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF > wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156). Is EST DTC list SPN 3482 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Enable Control (AFT: FEC) sensor connector.	Decision
A. Key OFF. B. Disconnect AFT: FEC sensor connector. C. Check AFT: FEC sensor connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FEC sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3482 FMI 3.

Step 3	Check vehicle harness / NOID lamp illumination.	Decision
A. Key OFF. B. Connect NOID lamp to vehicle harness and leave Aftertreatment Fuel Enable Control (AFT: FEC) disconnected. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156). Did NOID light illuminate?		Yes: Replace AFT: FEC. After repairs are complete, retest for SPN 3482 FMI 3. No: Go to Pin-Point Tests.

Step 4	Inspect connections at 86-pin Doser Control Unit (DCU).	Decision
A. Key OFF. B. Disconnect DCU. C. Check DCU and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing. Is 86-pin DCU module connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3482 FMI 3.

Pin-Point Tests (SPN 3482 FMI 3)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM)
- NOID lamp 15-909-01
- Terminal Test Kit ZTSE4435C

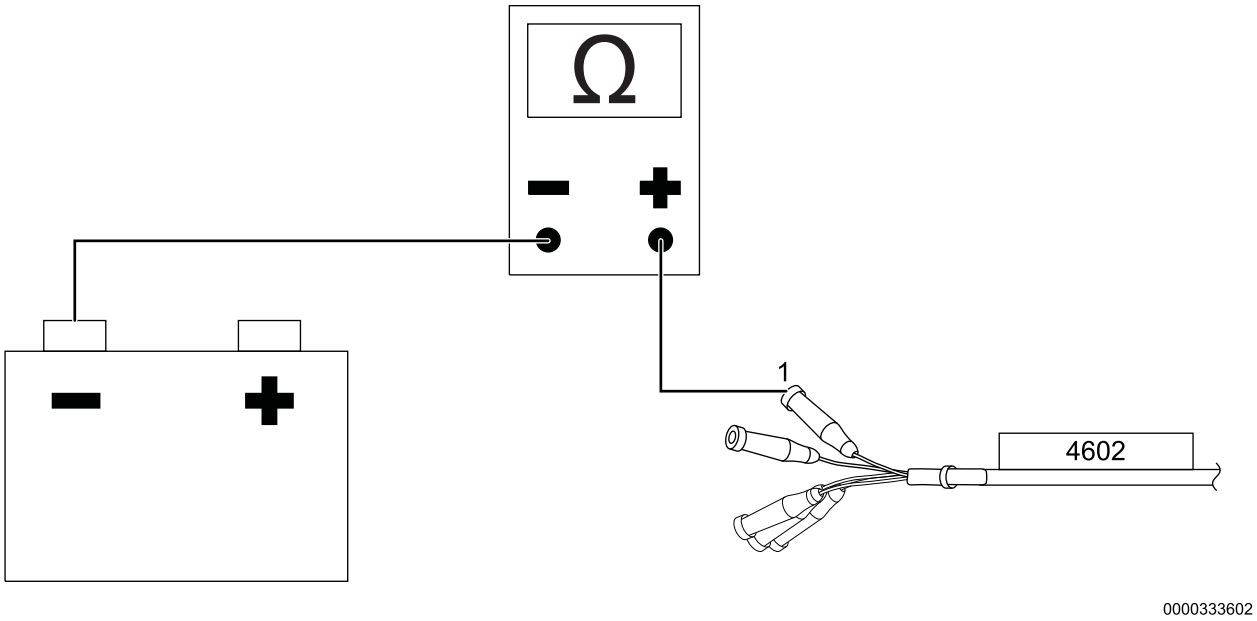


Figure 25 Test 1 AFT: FEC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Go to Test 2.

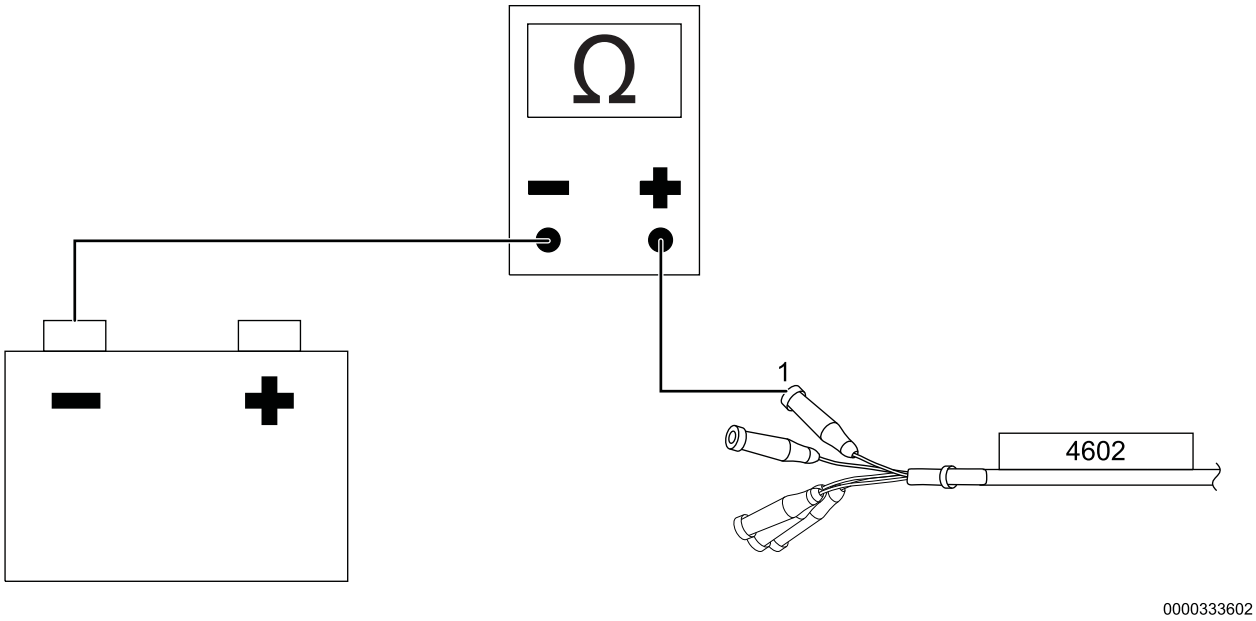


Figure 26 Test 2 AFT: FEC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave AFT: FEC disconnected. D. Disconnect 24-Pin Engine to Chassis connector.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-Pin Engine to Chassis connector pin-18 and Doser Control Unit (DCU) pin-31. After repairs are complete, retest for SPN 3482 FMI 3.
	No: Repair short to ground between 24-Pin Engine to Chassis connector pin-18 and AFT: FEC pin-1. After repairs are complete, retest for SPN 3482 FMI 3.

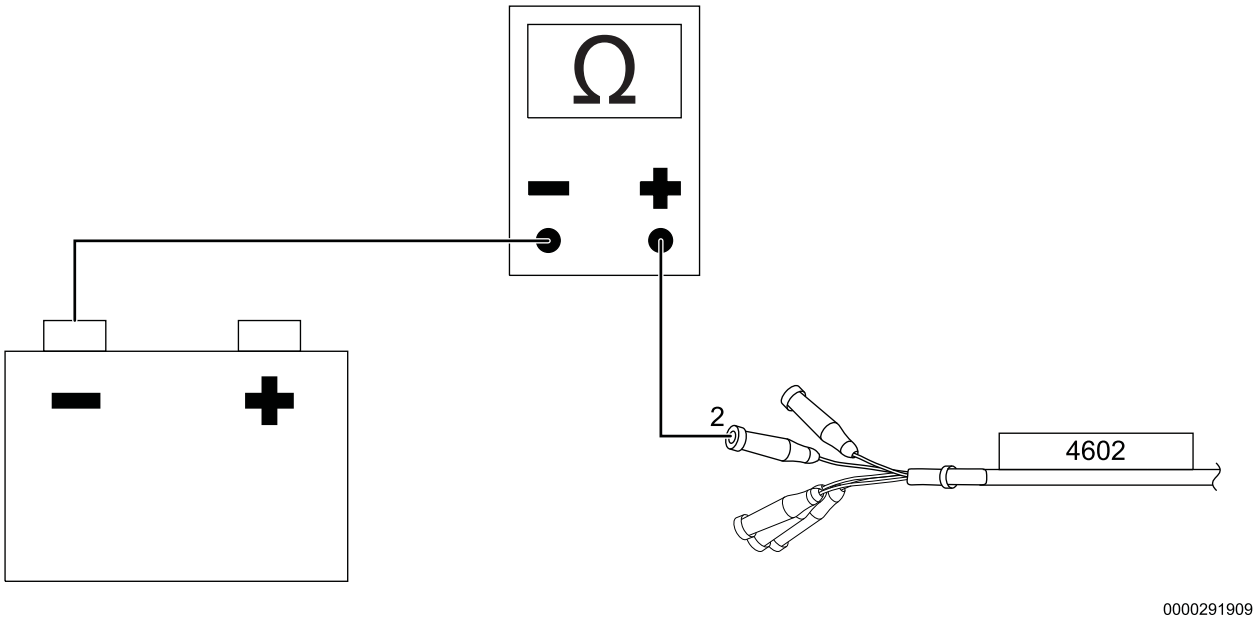


Figure 27 Test 3 AFT: FEC Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave AFT: FEC disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Go to Test 4.

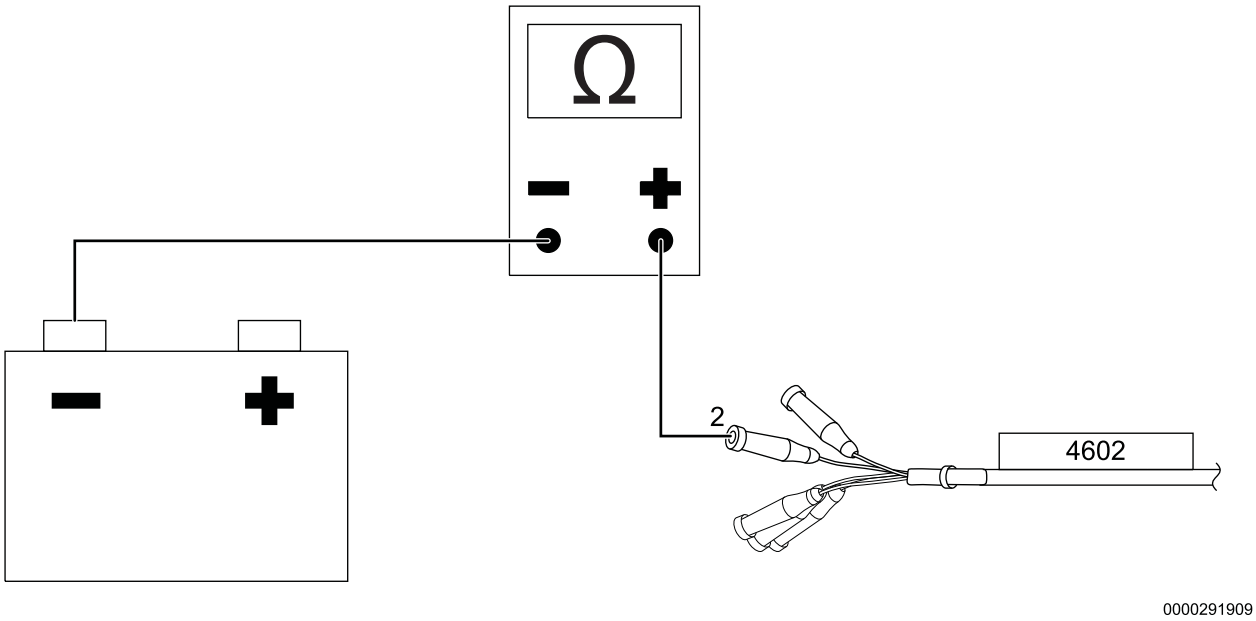


Figure 28 Test 4 AFT: FEC Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave AFT: FEC disconnected. D. Disconnect 24-Pin Engine to Chassis connector

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-Pin Engine to Chassis connector pin-19 and Doser Control Unit (DCU) pin-11. After repairs are complete, retest for SPN 3482 FMI 3.
	No: Repair short to ground between 24-Pin Engine to Chassis connector pin-19 and Aftertreatment Fuel Enable Control (AFT: FEC) pin-2. After repairs are complete, retest for SPN 3482 FMI 3.

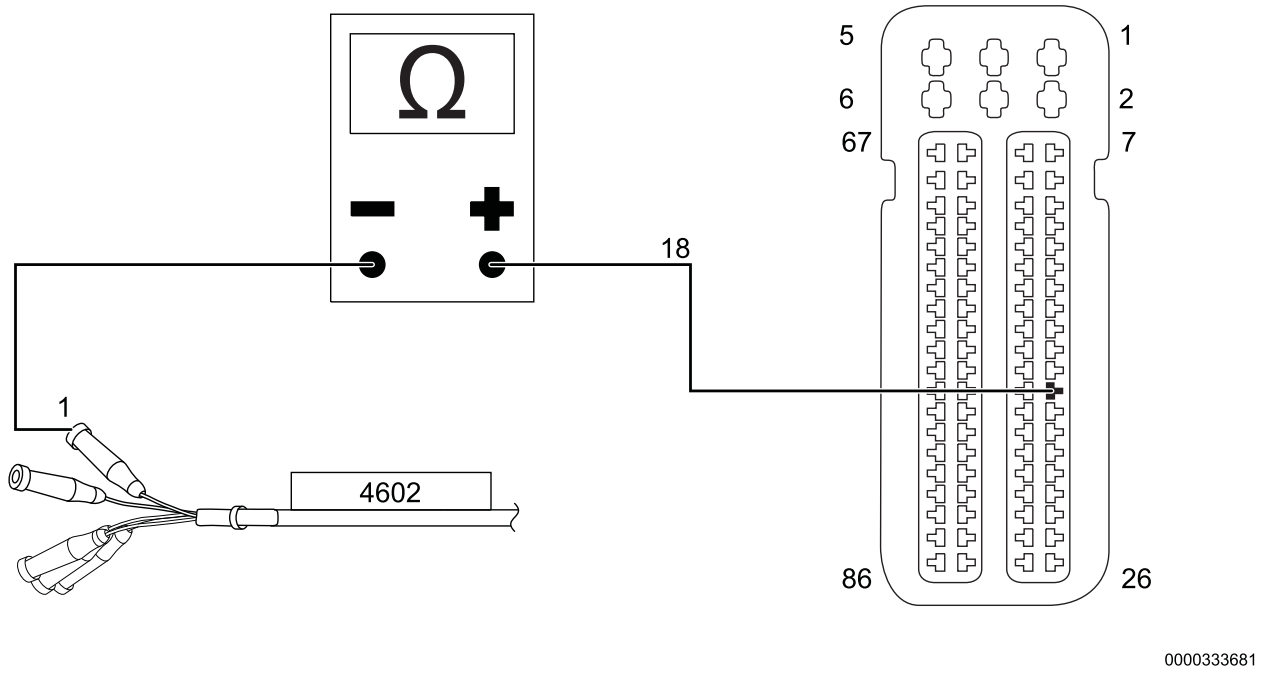


Figure 29 Test 5 AFT: FEC Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC) and 24-Pin Engine and Chassis connector. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave AFT: FEC disconnected. D. Connect Breakout Harness ZTSE6020 between 24-Pin Engine and Chassis connectors.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and Breakout Harness ZTSE6020 pin-18.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Diagnostic Step 4 (page 207).
	No: Repair Open between 24-Pin Engine to Chassis connector pin-18 and AFT: FEC pin-1. After repairs are complete, retest for SPN 3482 FMI 3.

Test 6 Setup
A. Key OFF. B. Disconnect 24-Pin Engine and Chassis connector and Doser Control Unit (DCU) module 86-Pin connector. C. Connect Breakout Harness ZTSE6020 between 24-Pin Engine and Chassis connectors. D. Using Terminal Test Kit ZTSE4435C, insert correct terminal into DCU module connector pin-31.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-18 and DCU Module pin-31.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7.
	No: Repair Open between 24-Pin Engine to Chassis connector pin-18 and DCU module pin-31. After repairs are complete, retest for SPN 3482 FMI 3.

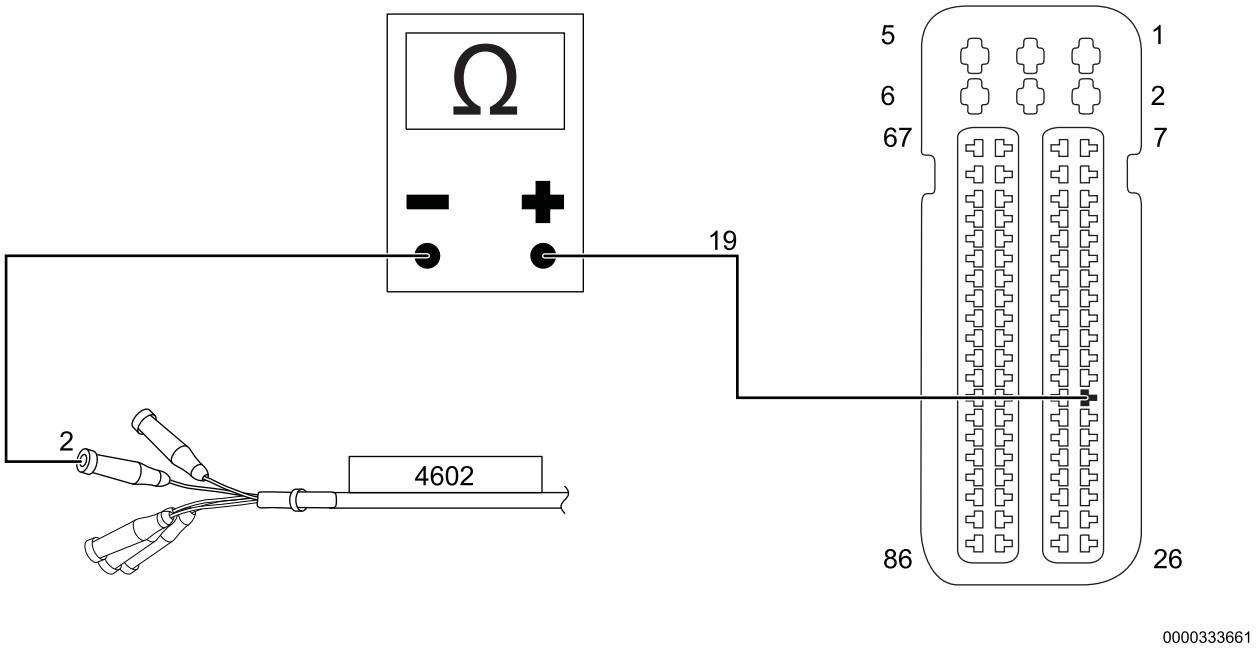


Figure 30 Test 7 AFT: FEC Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC) and 24-Pin Engine and Chassis connector. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave AFT: FEC disconnected. D. Connect Breakout Harness ZTSE6020 between 24-Pin Engine and Chassis connectors.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and Breakout Harness ZTSE6020 pin-19.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open between 24-Pin Engine to Chassis connector pin-19 and DCU module pin-11. After repairs are complete, retest for SPN 3482 FMI 3.
	No: Repair Open between 24-Pin Engine to Chassis connector pin-19 and AFT: FEC pin-2. After repairs are complete, retest for SPN 3482 FMI 3.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3482 FMI 3 fault code diagnostics.

SPN 3482 FMI 4 - AFT Fuel Enable Control Valve open or short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment 1 Fuel Enable Actuator Short to Ground	High / Low Side Circuit Voltage > 1.65 Volts AND < 2.35 Volts	Key ON Whenever Energized Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault Code sets when Doser Control Unit (DCU) Module detects signal from Aftertreatment Fuel Enable Control (AFT: FEC) actuator is shorted to ground.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

None

Fault Facts

Doser Control Unit (DCU) deactivates circuits when a circuit fault is present, so NOID light is needed to simulate correct circuit. Fault is latched for a key cycle, so Engine Control Module (ECM) must be reset by a Key OFF cycle.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FEC-H circuit Open or high resistance
- AFT: FEC-L circuit Open or high resistance
- AFT: FEC-H circuit short to ground
- AFT: FEC-L circuit short to ground
- Failed AFT: FEC

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF and wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) Aftertreatment Tests > Doser Actuator Test. Is EST DTC list SPN 3482 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Enable Control (AFT: FEC) sensor connector.	Decision
A. Key OFF. B. Disconnect AFT: FEC sensor connector. C. Check AFT: FEC sensor connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FEC sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3482 FMI 4.

Step 3	Check vehicle harness / NOID Lamp illumination.	Decision
A. Key OFF. B. Connect noid light to vehicle harness and leave AFT: FEC disconnected. C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156). Did NOID Lamp illuminate?		Yes: Replace AFT: FEC. After repairs are complete, retest for SPN 3482 FMI 4. No: Go to Pin-Point Tests(page 217).

Step 4	Inspect connections at 86-pin Doser Control Unit (DCU).	Decision
A. Key OFF. B. Disconnect DCU. C. Check DCU and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing. Are 86-pin DCU module connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests(page 217). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3482 FMI 4.

Pin-Point Tests (SPN 3482 FMI 4)

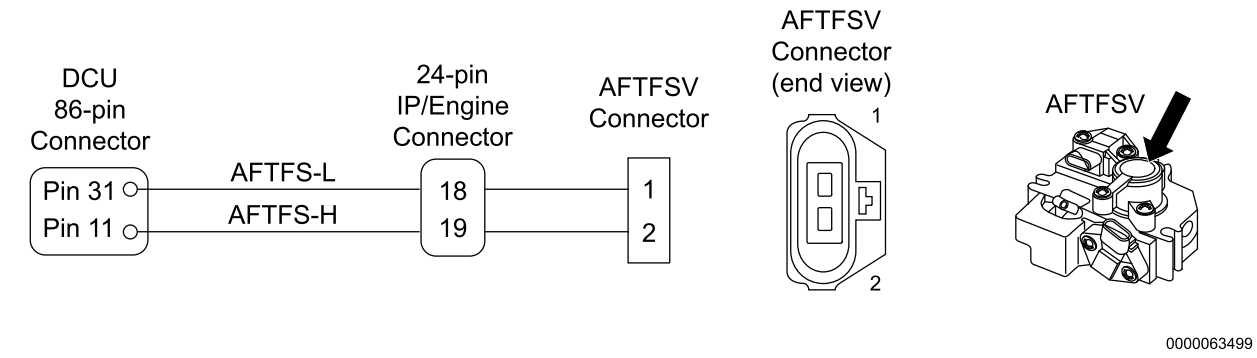


Figure 31 AFT: FEC Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM)
- NOID Lamp 15-909-01
- Terminal Test Kit ZTSE4435C

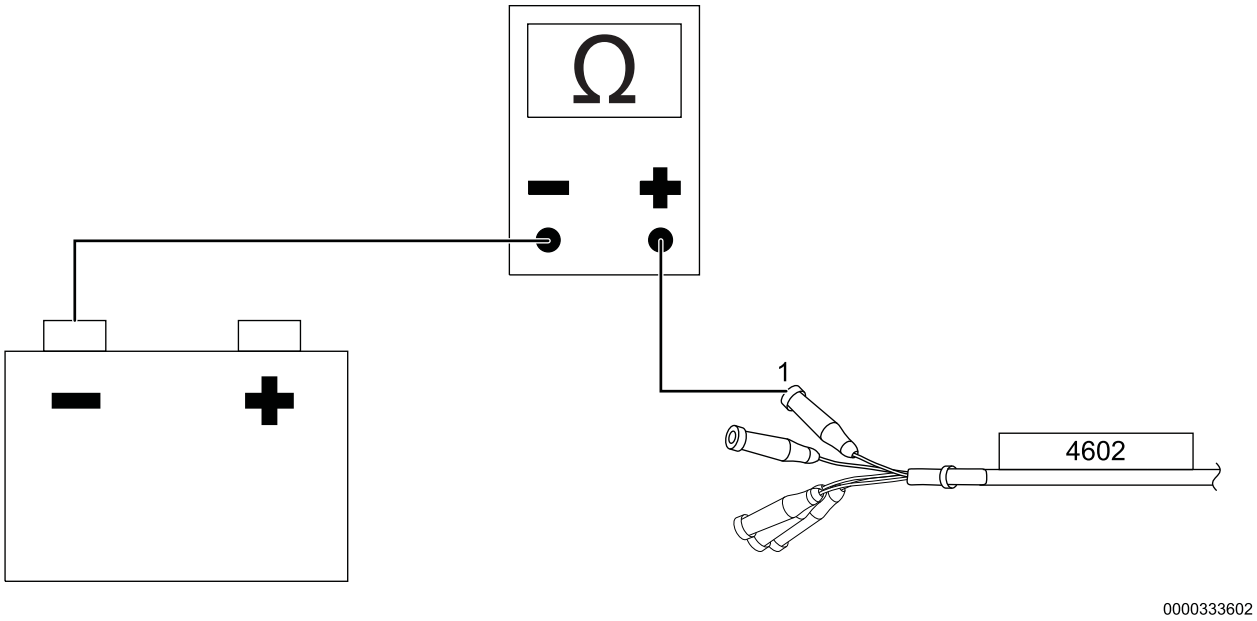


Figure 32 Test 1 AFT: FEC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Go to Test 2.

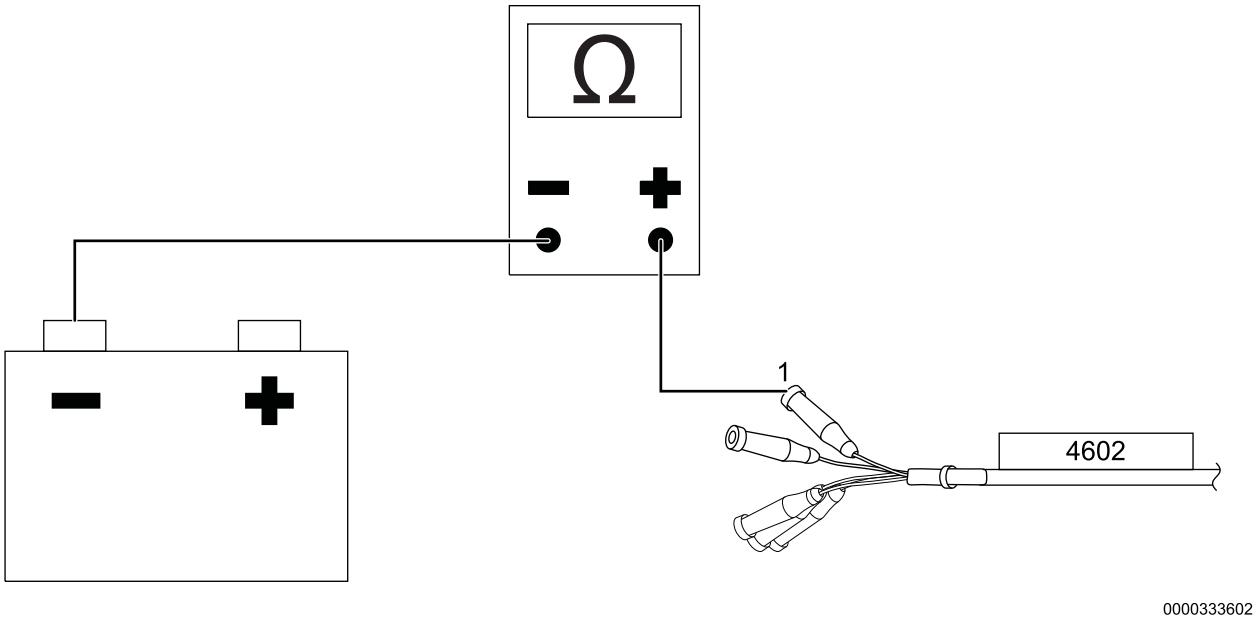


Figure 33 Test 2 AFT: FEC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Disconnect 24-pin Engine to Chassis connector.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin Engine to Chassis connector pin-18 and Doser Control Unit (DCU) pin-31. After repairs are complete, retest for SPN 3482 FMI 4.
	No: Repair short to ground between 24-pin Engine to Chassis connector pin-18 and AFT: FEC pin-1. After repairs are complete, retest for SPN 3482 FMI 4.

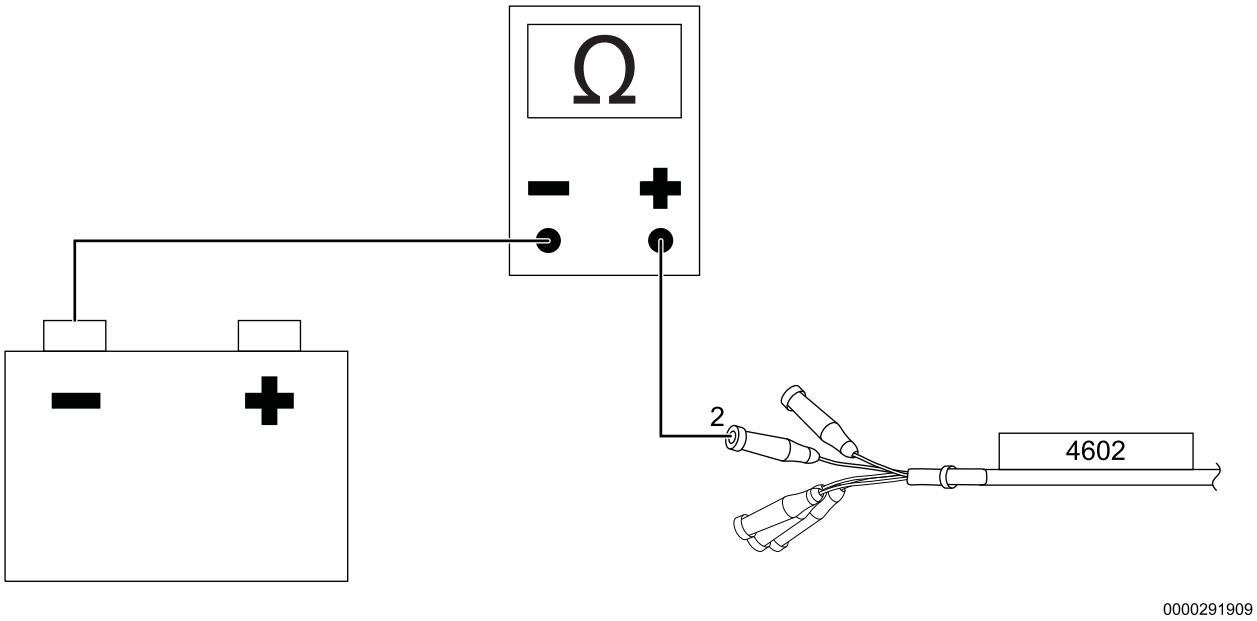


Figure 34 Test 3 AFT: FEC Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Go to Test 4.

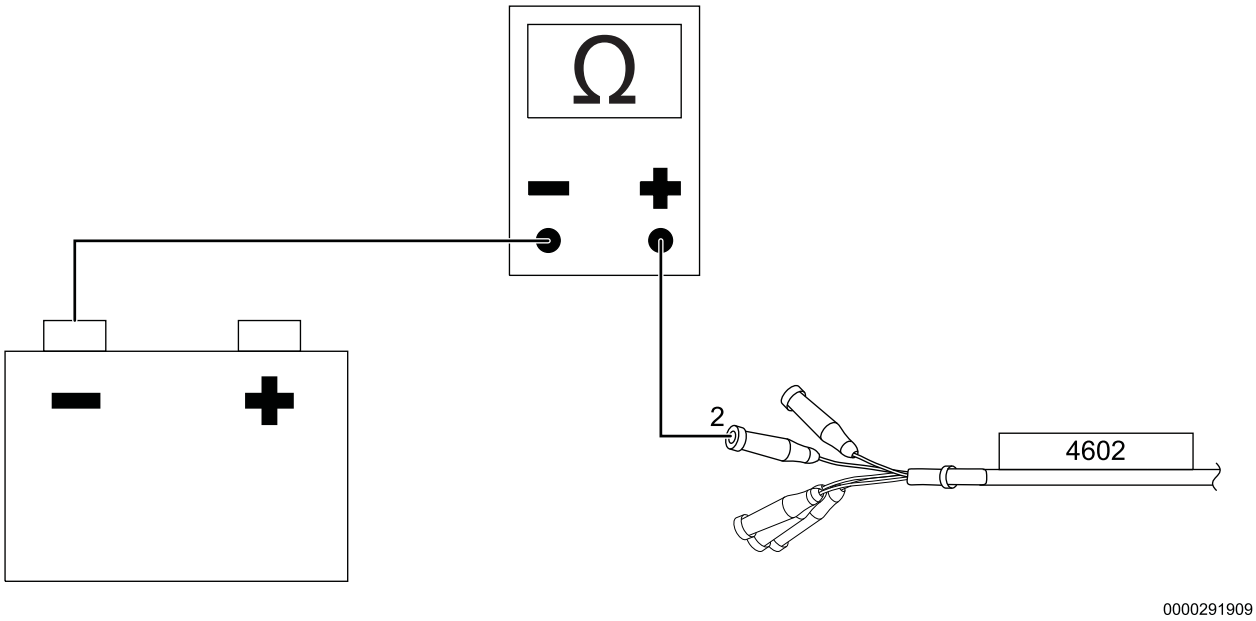


Figure 35 Test 4 AFT: FEC Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC). C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Disconnect 24-pin Engine to Chassis connector.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin Engine to Chassis connector pin-19 and Doser Control Unit (DCU) pin-11. After repairs are complete, retest for SPN 3482 FMI 4.
	No: Repair short to ground between 24-pin Engine to Chassis connector pin-19 and AFT: FEC pin-2. After repairs are complete, retest for SPN 3482 FMI 4.

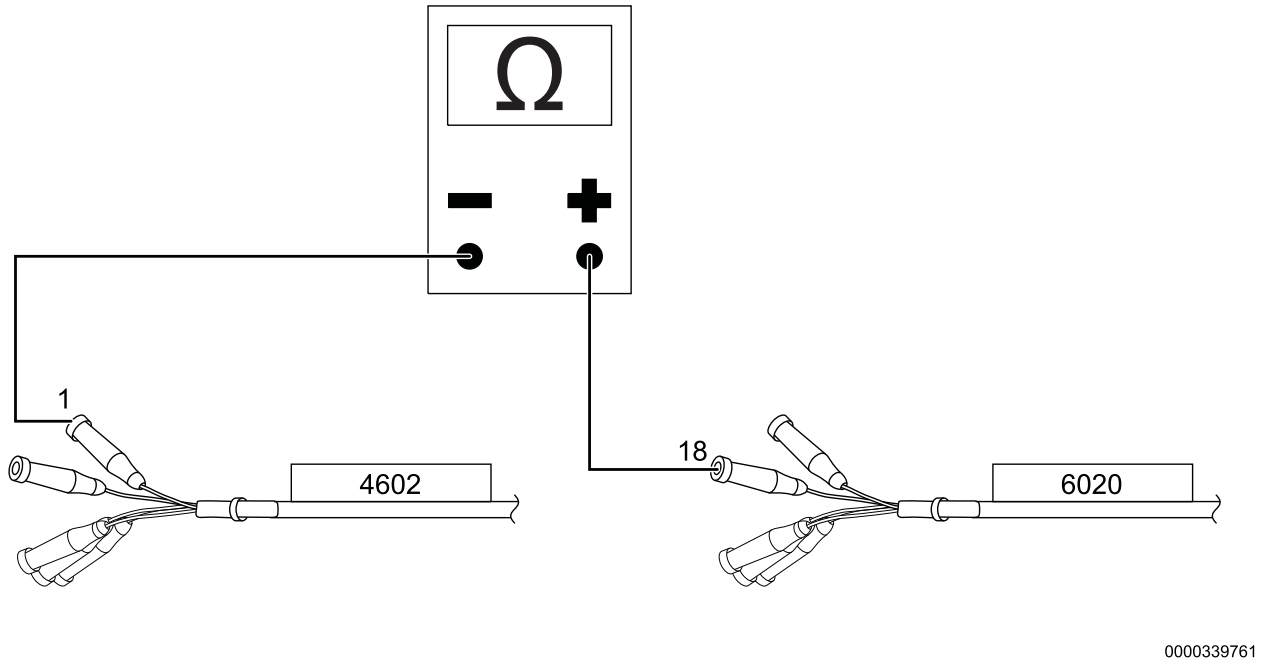


Figure 36 Test 5 AFT: FEC Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC) and 24-Pin Engine and Chassis connectors. C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine and Chassis disconnected. E. Key ON.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and Breakout Harness ZTSE6020 pin-18.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Diagnostic Step 4 (page 217).
	No: Repair Open between 24-pin Engine to Chassis connector pin-18 and AFT: FEC pin-1. After repairs are complete, retest for SPN 3482 FMI 4.

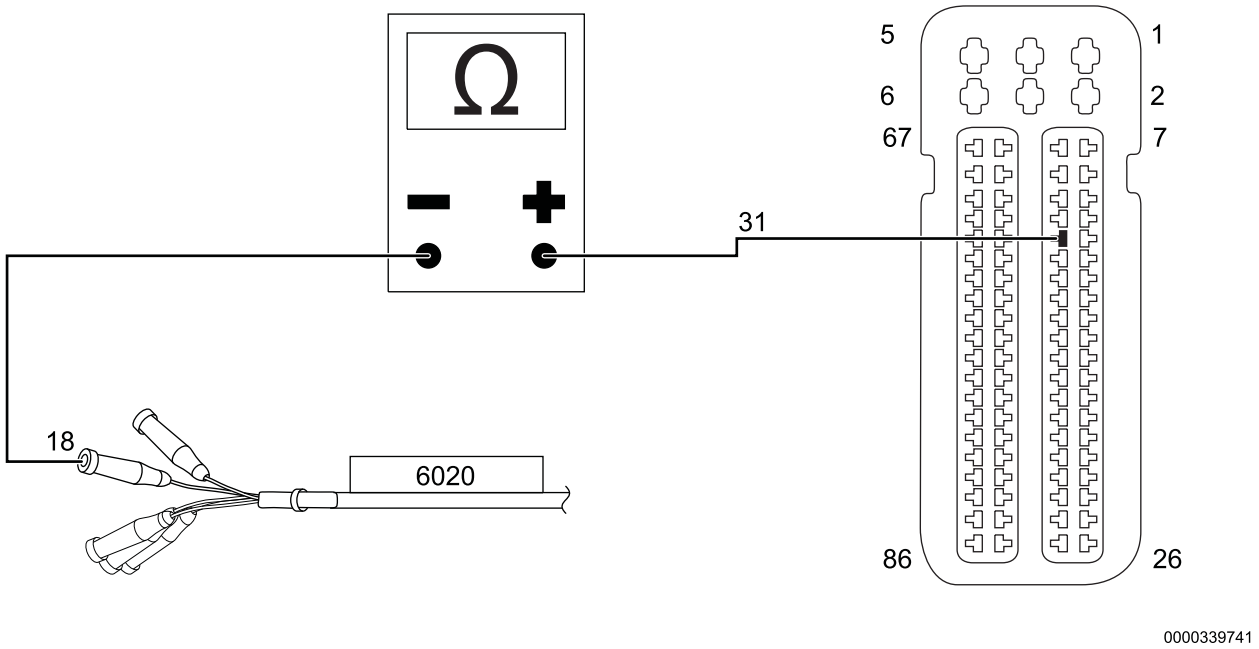


Figure 37 Test 6 AFT: FEC Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 24-Pin Engine and Chassis and Doser Control Unit (DCU) module 86-Pin connectors. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine and Chassis connector disconnected. D. Using Terminal Test Kit ZTSE4435C, insert correct terminal into Doser Control Unit (DCU) module 86-Pin connector pin-31. E. Key ON.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-18 and DCU Module pin-31.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7.
	No: Repair Open between 24-pin Engine to Chassis connector pin-18 and DCU module pin-31. After repairs are complete, retest for SPN 3482 FMI 4.

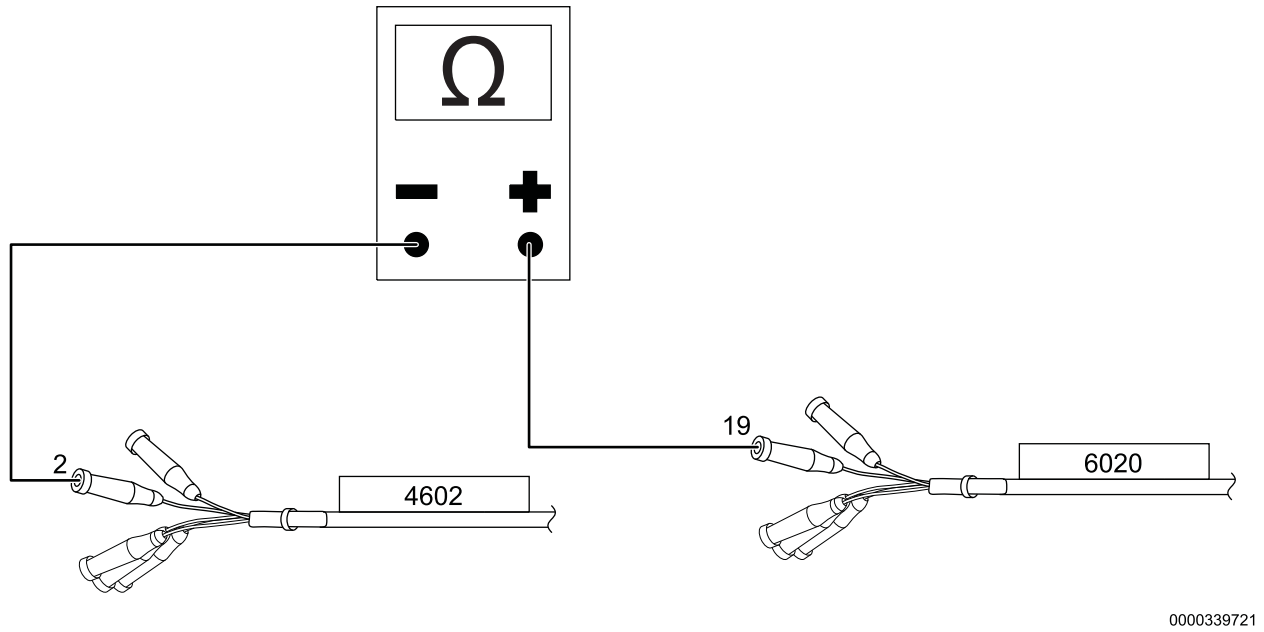


Figure 38 Test 7 AFT: FEC Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Enable Control (AFT: FEC) and 24-Pin Engine and Chassis connectors. C. Connect Breakout Harness ZTSE4602 to vehicle harness and leave AFT: FEC disconnected. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine and Chassis disconnected. E. Key ON.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4602 pin-2 and Breakout Harness ZTSE6020 pin-19.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open between 24-pin Engine to Chassis connector pin-19 and DCU module pin-11. After repairs are complete, retest for SPN 3482 FMI 4.
	No: Repair Open between 24-pin Engine to Chassis connector pin-19 and AFT: FEC pin-2. After repairs are complete, retest for SPN 3482 FMI 4.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3482 FMI 4 fault code diagnostics.

AFT: FP1 / AFT: FT (Aftertreatment Fuel Pressure 1 / Aftertreatment Fuel Temperature) Sensor

Overview of AFT: FP1 / AFT: FT Sensor Group

SPN	FMI	Description
3480	3	AFTFP1 signal Out of Range HIGH (page 228)
3480	4	AFTFP1 signal Out of Range LOW (page 235)
5456	2	AFTFT signal erratic, intermittent, or incorrect (page 242)
5456	3	AFTFT signal Out of Range HIGH (page 247)
5456	4	AFTFT signal Out of Range LOW (page 253)

Overview

Aftertreatment Fuel Pressure 1 / Aftertreatment Fuel Temperature (AFT: FP1 / AFT: FT) is comprised of a fuel temperature and fuel pressure sensor. AFT: FP1 / AFT: FT monitors fuel pressure and fuel temperature in aftertreatment fuel system and provides feedback signal to Doser Control Unit (DCU).

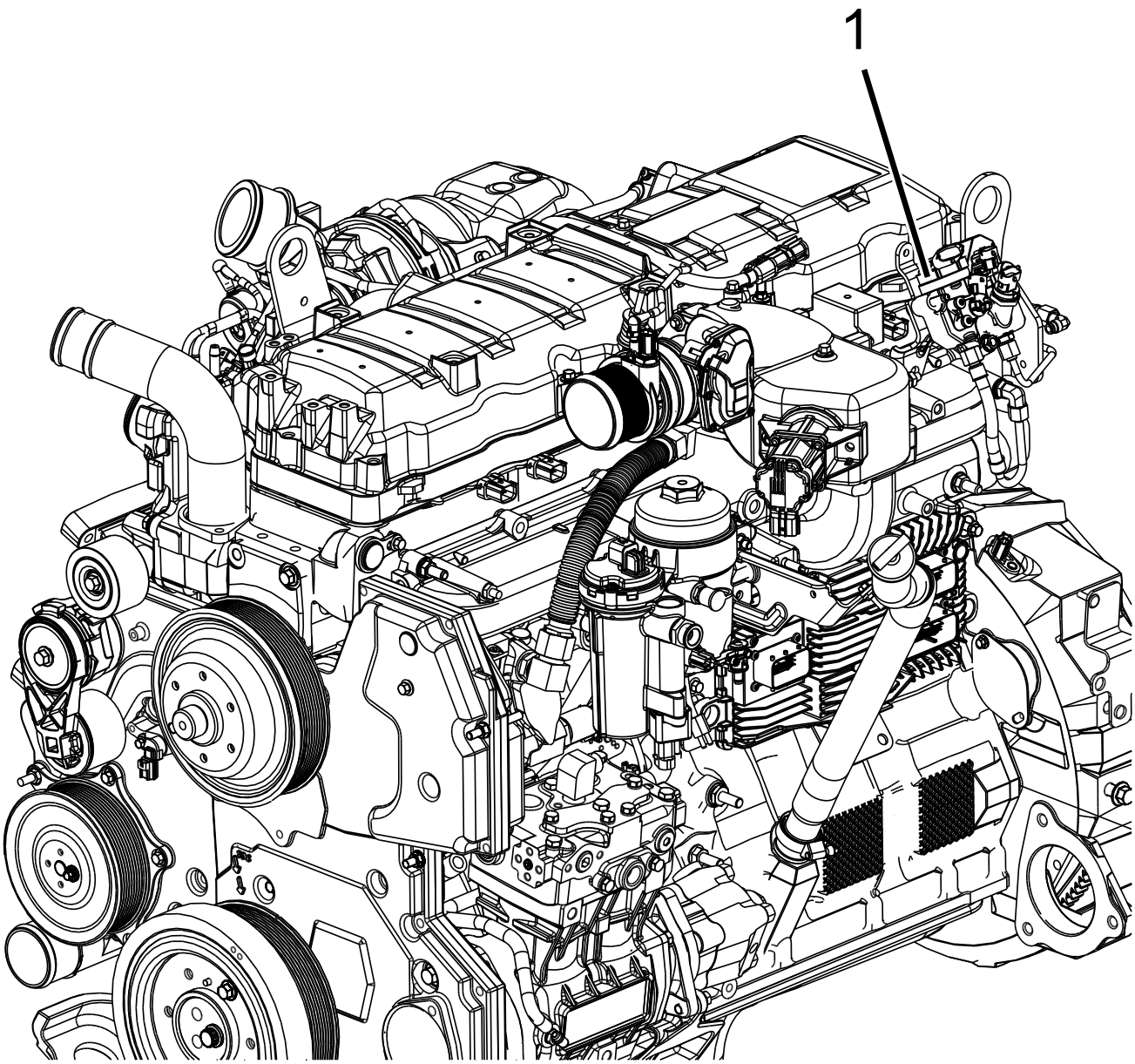


Figure 39 AFT: FP1 / AFT: FT Sensor Location

1. AFT: FP1 / AFT: FT Sensor

SPN 3480 FMI 3 - AFT: FP1 signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel Pressure 1 (AFT: FP1) signal is greater than expected.	AFT: FP1 signal voltage > 4.85 volts (> 173 psi [1192 kPa])	Key ON Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Aftertreatment Fuel Pressure 1 (AFT: FP1) signal voltage is greater than 4.85 volts. Engine torque may be reduced if the engine is operated for an extended period of time with this fault active. Active regeneration of the aftertreatment system may be disabled until the next key cycle.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FP1 signal circuit Open
- AFT: FP1 signal circuit short to PWR
- AFT: FP1 SIG GND Open
- Failed AFT: FP1 / AFT: FT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3480 FMI 3. Is EST DTC list SPN 3480 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT).	Decision
A. Key OFF. B. Disconnect AFT: FP1 / AFT: FT connector. C. Check AFT: FP1 / AFT: FT and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP1 / AFT: FT connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3480 FMI 3.

Pin-Point Tests (SPN 3480 FMI 3)

AFT: FP1/ AFT: FT Circuit

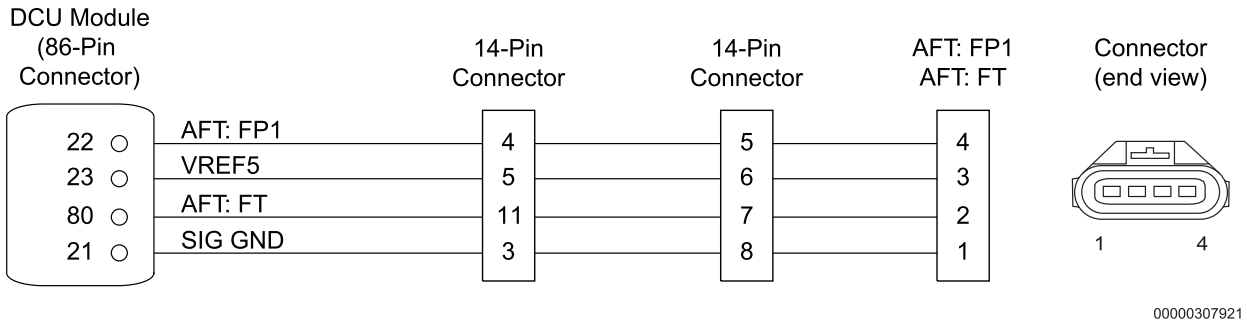


Figure 40 AFT: FP1 / AFT: FT Circuit Diagram

See latest version of Navistar® N9 and N10 Engine Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4830
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

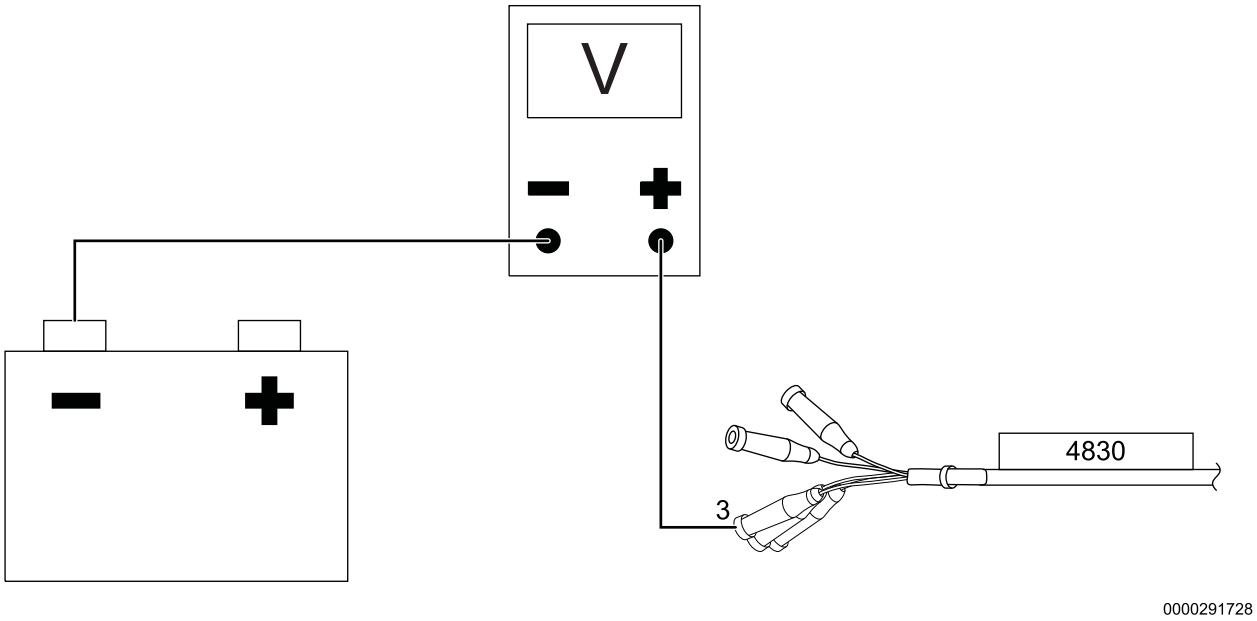


Figure 41 Test 1 VREF5 Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-3 and known good GND.	5 volts ± 1 volt
Decision	
Is voltage 5 volts ± 1 volt?	Yes: Go to Test 2.
	No: Repair Open between AFT: FP1 / AFT: FT pin-3 and DCU Module pin-23. After repairs are complete, retest for SPN 3480 FMI 3.

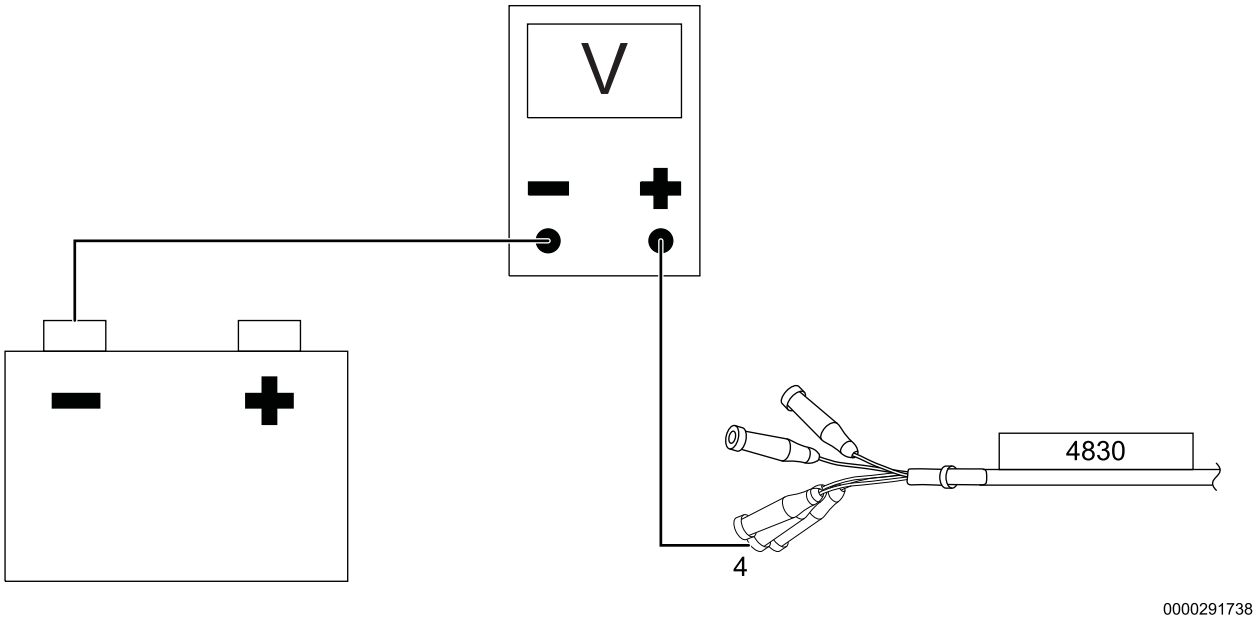
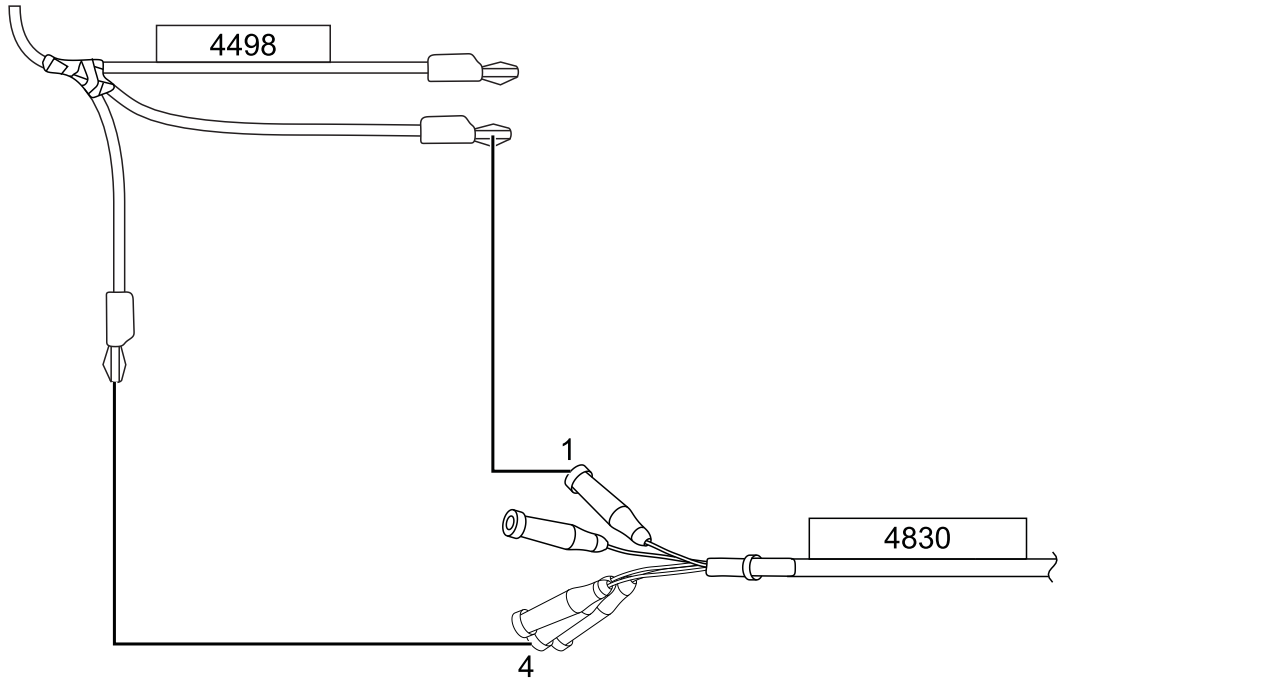


Figure 42 Test 2 AFT: FP1 Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-4 and known good GND.	Less than 6.0 volts
Decision	
Is voltage less than 6.0 volts?	Yes: Go to Test 3.
	No: Repair short to PWR between AFT: FP1 / AFT: FT pin-4 and Doser Control Unit (DCU) pin-22. After repairs are complete, retest for SPN 3480 FMI 3.



0000305583

Figure 43 Test 3 AFT: FP1 Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Using Breakout Harness ZTSE4498, short pin-1 and pin-4 of Breakout Harness ZTSE4830 together. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3480 FMI 4
Decision	
Does SPN 3480 FMI 4 set after DTC list is cleared?	Yes: Replace AFT: FP1 / AFT: FT sensor. After repairs are complete, retest for SPN 3480 FMI 3.
	No: Go to Test 4.

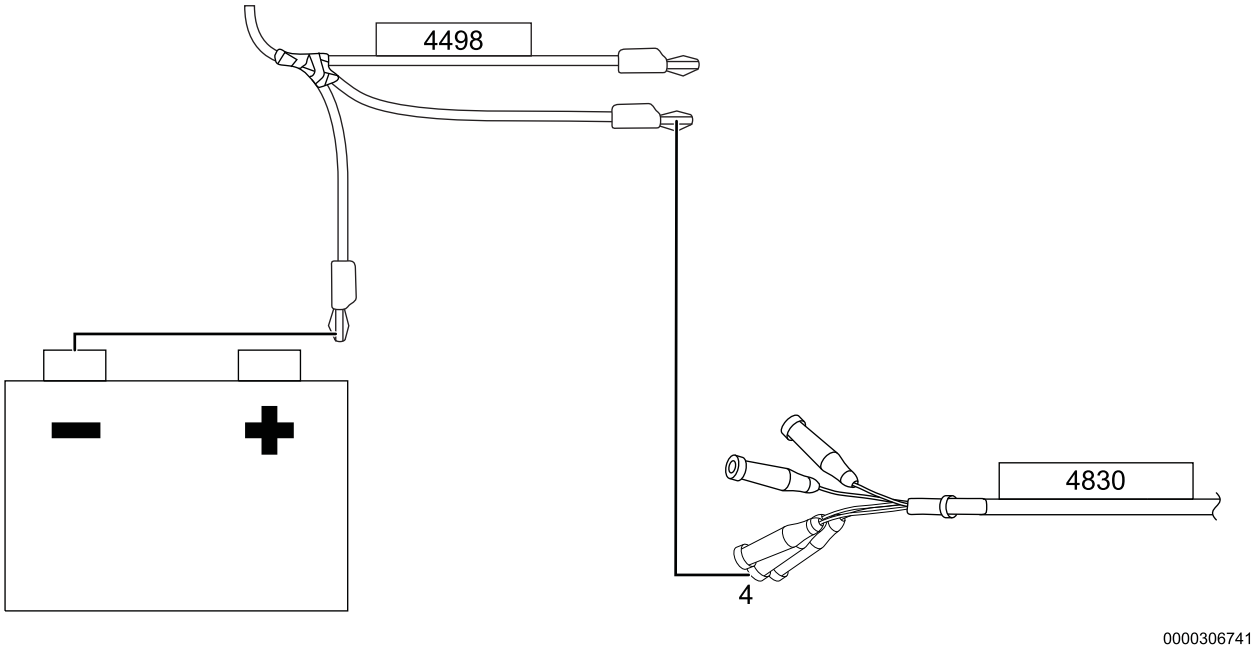


Figure 44 Pin-Point Test 3 AFT: FP1 Circuit Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Using Breakout Harness ZTSE4498, short pin-4 of Breakout Harness ZTSE4830 to know good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 4	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3480 FMI 4 sets in DTC list.
Decision	
Does SPN 3480 FMI 4 set after DTC list is cleared?	Yes: Repair Open between AFT: FP1 / AFT: FT pin-1 and Doser Control Unit (DCU) pin-21. After repairs are complete, retest for SPN 3480 FMI 3.
	No: Repair Open between AFT: FP1 / AFT: FT pin-4 and DCU pin-22. After repairs are complete, retest for SPN 3480 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3480 FMI 3 fault code diagnostics.

SPN 3480 FMI 4 - AFTFP1 signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel Pressure 1 (AFT: FP1) signal is less than expected.	AFT: FP1 voltage < 0.25 Volts (< 2.3 psi [-15.65 kPa])	Key ON Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault code sets when the Engine Control Module (ECM) detects Aftertreatment Fuel Pressure 1 (AFT: FP1) signal voltage is less than 0.25 volts for 2 seconds. Active aftertreatment regeneration disabled until the next key cycle. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FP1 signal circuit short to GND
- Open VREF
- Failed AFT: FP1 / AFT: FT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3480 FMI 4. Is EST DTC list SPN 3480 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at AFT: FP1 / AFT: FT connector.	Decision
A. Key OFF. B. Disconnect AFT: FP1 / AFT: FT connector. C. Check AFT: FP1 / AFT: FT and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP1 / AFT: FT connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3480 FMI 4.

Pin-Point Tests (SPN 3480 FMI 4)

AFT: FP1 Circuit

AFT: FP1/ AFT: FT Circuit

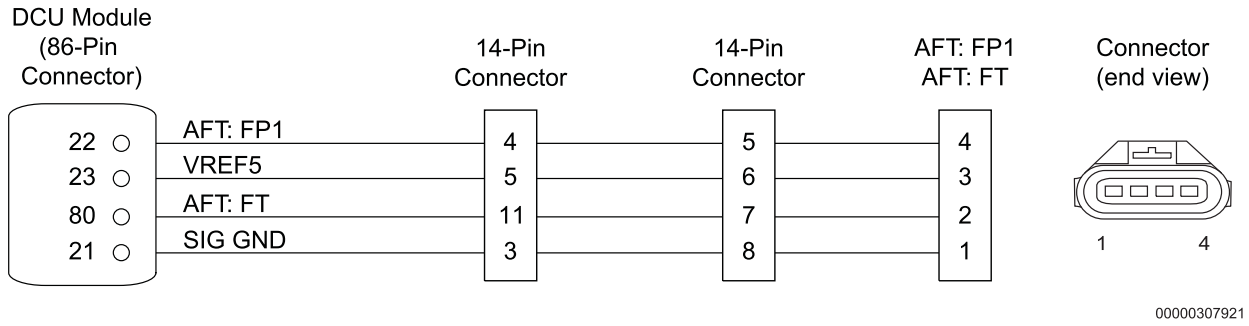


Figure 45 AFT: FP1 / AFT: FT Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4830
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

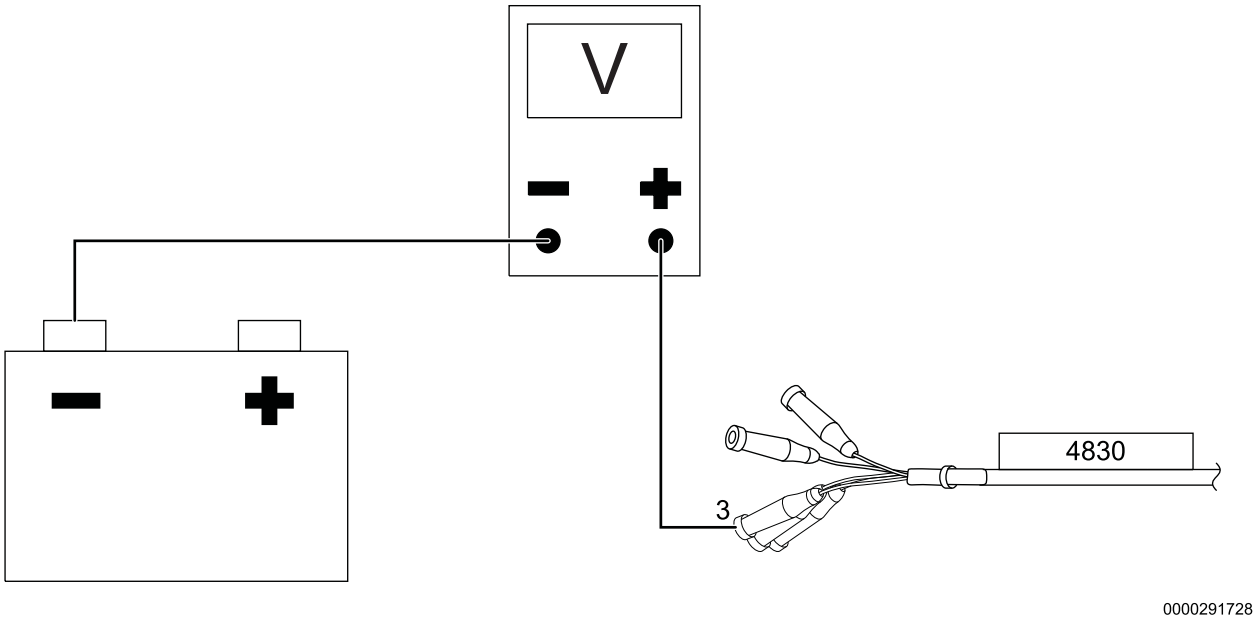


Figure 46 Test 1 VREF 5 Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-3 and known good GND.	5 volts ± 1 volt
Decision	
Is voltage 5 volts ± 1 volt?	Yes: Go to Test 2.
	No: Repair Open between AFT: FP1 / AFT: FT pin-3 and DCU Module pin-23. After repairs are complete, retest for SPN 3480 FMI 4.

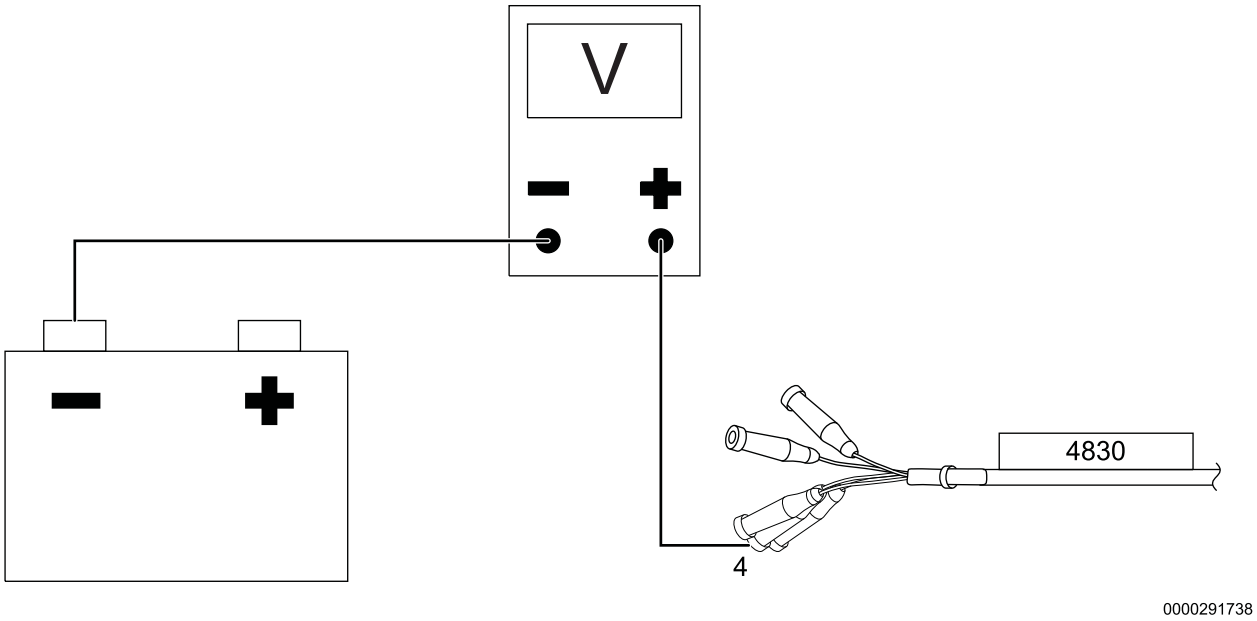


Figure 47 Test 2 AFT: FP1 Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-4 and known good GND.	Less than 6.0 volts
Decision	
Is voltage less than 6.0 volts?	Yes: Go to Test 3.
	No: Repair short to PWR between AFT: FP1 / AFT: FT pin-4 and Doser Control Unit (DCU) pin-22. After repairs are complete, retest for SPN 3480 FMI 4.

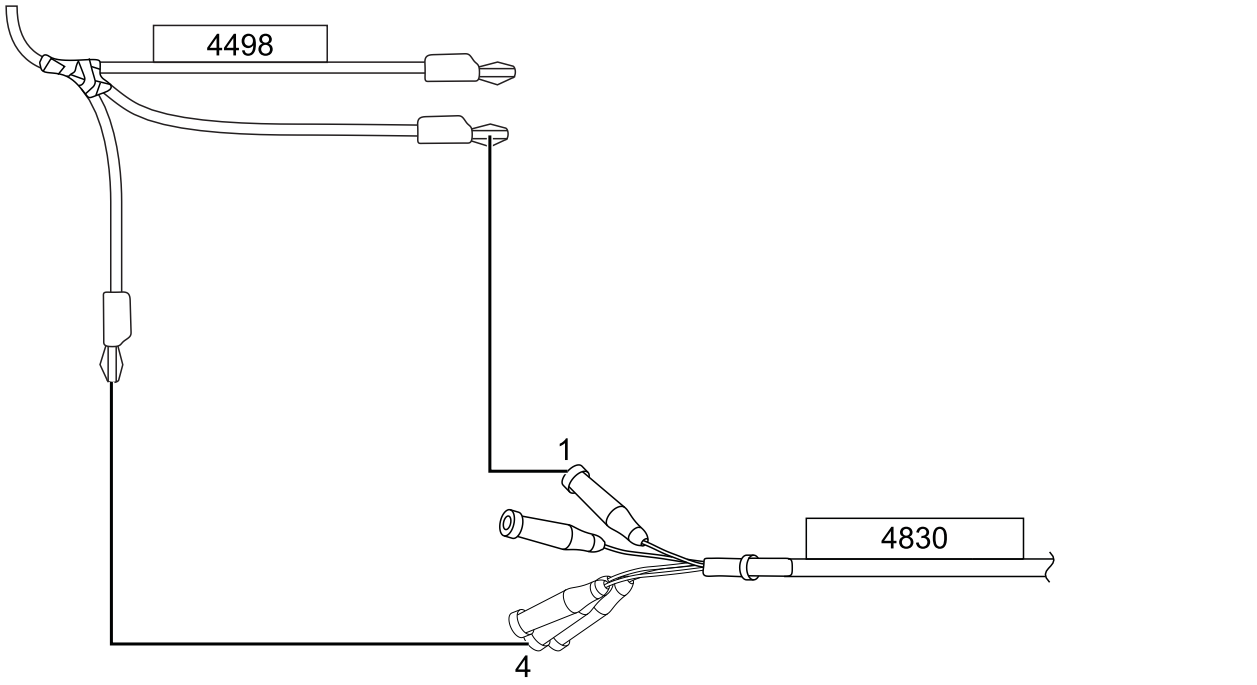


Figure 48 Test 3 AFT: FP1 Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Using Breakout Harness ZTSE4498, short pin-1 and pin-4 of Breakout Harness ZTSE4830 together. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3480 FMI 3
Decision	
Does SPN 3480 FMI 3 set after DTC list is cleared?	Yes: Replace AFT: FP1 / AFT: FT sensor. After repairs are complete, retest for SPN 3480 FMI 4.
	No: Go to Test 4.

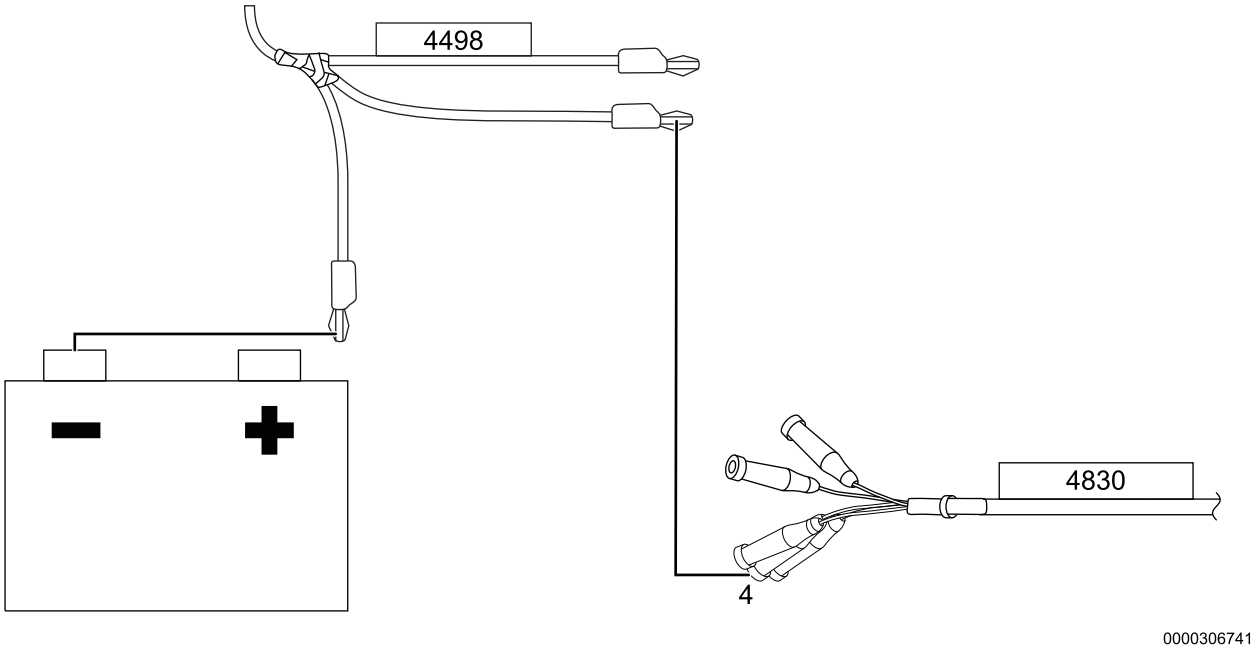


Figure 49 Pin-Point Test 3 AFT: FP1 Circuit Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1) / Aftertreatment Fuel Temperature (AFT: FT) connector. C. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected. D. Using Breakout Harness ZTSE4498, short pin-4 of Breakout Harness ZTSE4830 to know good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 4	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3480 FMI 3.
Decision	
Does SPN 3480 FMI 3 set after DTC list is cleared?	Yes: Repair Open between AFT: FP1 / AFT: FT pin-1 and Doser Control Unit (DCU) pin-21. After repairs are complete, retest for SPN 3480 FMI 4.
	No: Repair Open between AFT: FP1 / AFT: FT pin-4 and DCU pin-22. After repairs are complete, retest for SPN 3480 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3480 FMI 4 fault code diagnostics.

SPN 5456 FMI 2 - AFTFT Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Condition / Values
Aftertreatment Fuel Temperature (AFT: FT) does not agree with Intake Air Temperature (IAT), Turbocharger Charger 2 Compressor Intake Temperature (TC2CIT), Charge Air Cooler Outlet Temperature (CACOT), Engine Coolant Temperature 1 (ECT1), or Engine Oil Temperature (EOT) after a cold soak.	AFT: FT > reference temperature value or AFT: FT < reference temperature value Difference between AFT: FT and IMT, IAT, TC2CIT, CACOT, ECT, EOT, EFT > 59°F (15°C)	Key ON Cold soaked for 8 hours.

Fault Overview

Fault sets when Engine Control Module (ECM) detects difference between actual Aftertreatment Fuel Temperature (AFT: FT) and measured AFT: FT is incorrect or erratic.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 105 FMI 2, 3, and 4 (IMT)	SPN 110 FMI 2, 3, and 4 (ECT1)	SPN 175 FMI 2, 3, and 4 (EOT)	SPN 1173 FMI 2, 3, and 4 (TC2CIT)
SPN 2630 FMI 2, 3, and 4 (CACOT)	SPN 5456 FMI 3 and 4 (AFT: FT)		

Fault Facts

None

Drive Cycle

Continuous

Possible Causes

- Incorrect DCU for ECM.
- AFT: FT circuit high resistance
- SIG GND circuit high resistance
- Failed AFT: FT

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults (page 242). Is EST DTC list free of Associated Faults?		Yes: Go to step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5456 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5456 FMI 2. Is EST DTC list SPN 5456 FMI 2 active or pending?		Yes: Go to step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123)

Step 3	Check for correct DCU part number.	Decision
Using EST with ServiceMaxx™ software, check for correct Doser Control Unit (DCU) part number. Does DCU match correct part number for model year of engine?		Yes: Go to step 4. No: Install correct DCU for model year of engine. After repairs are complete, retest for SPN 5456 FMI 2.

Step 4	Inspect connections at AFT: FP1 / AFT: FT connector	Decision
A. Key OFF B. Disconnect AFT: FP1 / AFT: FT. C. Check AFT: FP1 / AFT: FT sensor and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing. Are AFT: FP1 / AFT: FT sensor connector, harness, and terminals clean and undamaged?		Yes: Go to step 5. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5456 FMI 2.

Step 5	Check for Failed AFT: FT	Decision
Perform Test 1 (page 245). Using EST with ServiceMaxx™ software, check AFT: FT signal voltage. Is voltage less than 0.5 volts?		Yes: Replace AFT: FIS. After repairs are complete, retest for SPN 5456 FMI 2. No: Go to step 6.

Step 6	Check for Open in SIG GND circuit.	Decision
Perform Test 2 (page 246). Using a DMM measure resistance between Breakout Harness ZTSE4830 pin-1 and known good GND. Is resistance less than 5 ohms?		Yes: Repair Open between AFT: FP1 / AFT: FT pin-2 and DCU Module pin-80. After repairs are complete, retest for SPN 5456 FMI 2. No: Repair Open between AFT: FP1 / AFT: FT pin-1 and DCU Module pin-21. After repairs are complete, retest for SPN 5456 FMI 2.

Pin - Point Tests (SPN 5456 FMI 2)

AFT: FP1/ AFT: FT Circuit

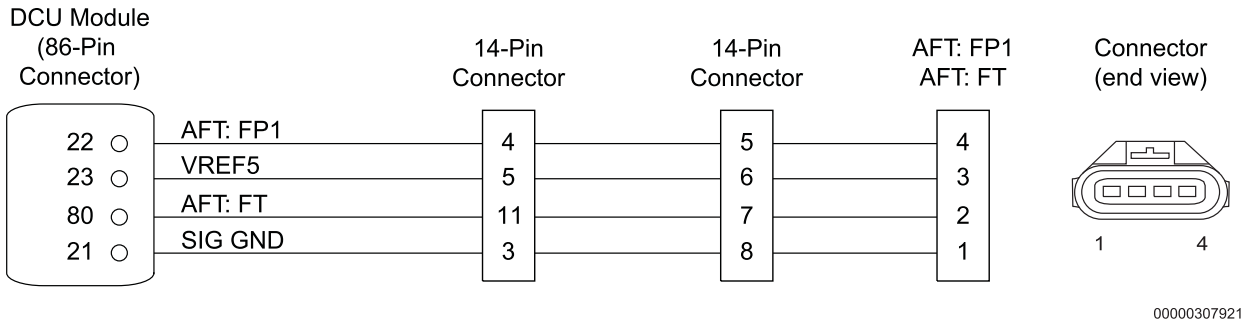
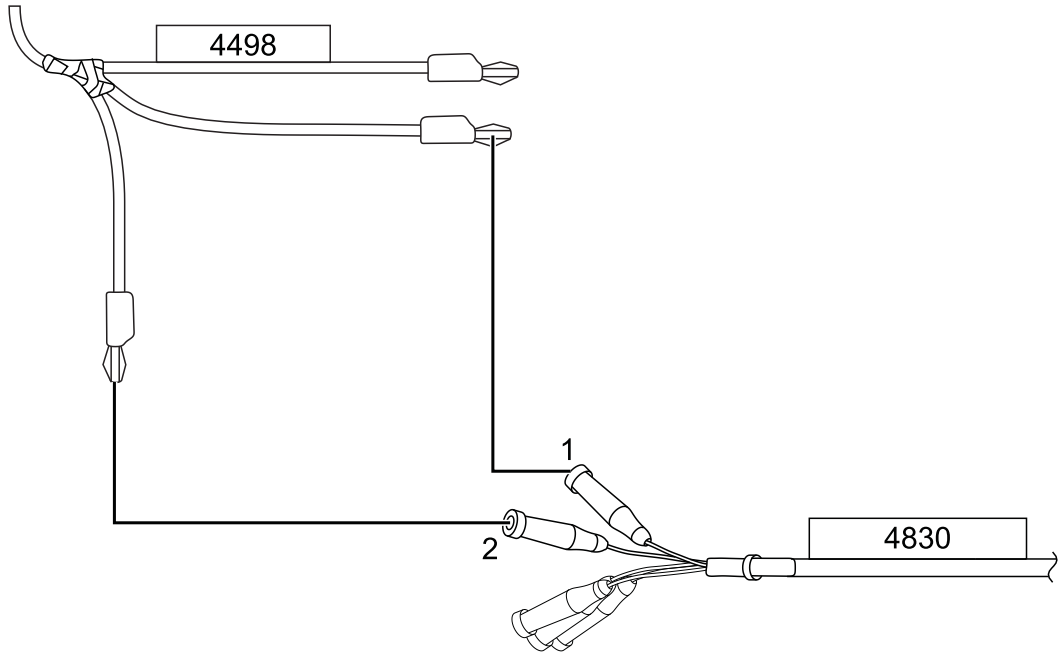


Figure 50 AFT: FP1 / AFT: FT Circuit Diagram

NOTE: See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Breakout Harness ZTSE4830
- Digital Multimeter (DMM)
- 3-Banana Plug Harness ZTSE4498



0000304763

Test 1 Setup
A. Key OFF
B. Connect Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 / AFT: FT sensor disconnected.
C. Using Breakout Harness ZTSE4498 short Breakout Harness ZTSE4830 pin-1 and pin-2.

Test 2 Setup
A. Key OFF B. Connect Breakout Harness ZTSE4830 to AFT: FP1 / AFT: FT vehicle harness and leave AFT: FP1 / AFT: FT disconnected.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and proper decision was made. Return to SPN 5456 FMI 2 fault code diagnostics.

SPN 5456 FMI 3 - AFTFT Signal Out of Range - HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Fuel Temperature (AFT: FT) sensor signal is out of range (high).	AFT: FT circuit > 4.75 Volts	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Aftertreatment Fuel Temperature (AFT: FT) sensor is reading greater than 4.75 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

TBD

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Aftertreatment (AFT) signal short to PWR
- AFT: FT signal circuit open
- Signal ground open
- Failed AFT: FP1 / AFT: FT (open)

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5456 FMI 3 (AFT: FT). Does EST DTC list show 5456 FMI 3 as active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123)

Step 2	Inspect connections at Aftertreatment Fuel Pressure 1 / Aftertreatment Fuel Temperature (AFT: FP1 / AFT: FT) sensor connector	Decision
A. Key OFF. B. Disconnect AFT: FP1 / AFT: FT sensor e connector. C. Check AFT: FP1 / AFT: FT sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP1 / AFT: FT sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5456 FMI 3.

Pin-Point Tests (SPN 5456 FMI 3)

AFT: FP1/ AFT: FT Circuit

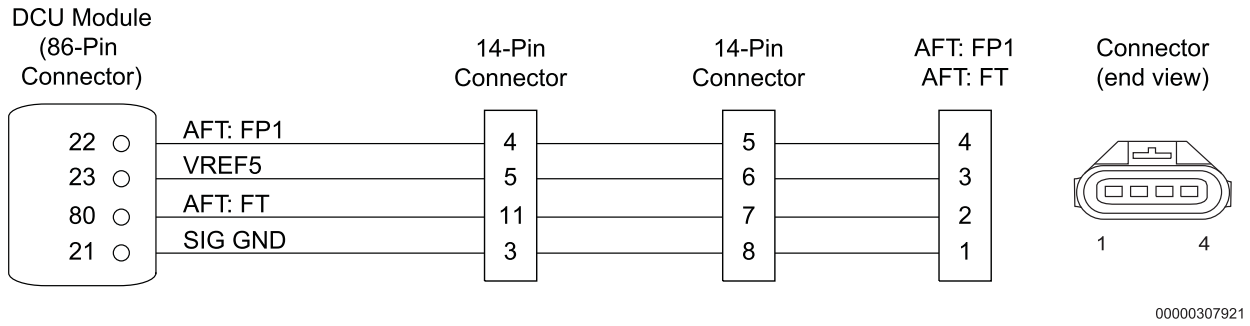


Figure 52 AFT: FP1 / AFT: FT Circuit Diagram

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4830
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)
- International® Electronic Engine Terminal Test Kit

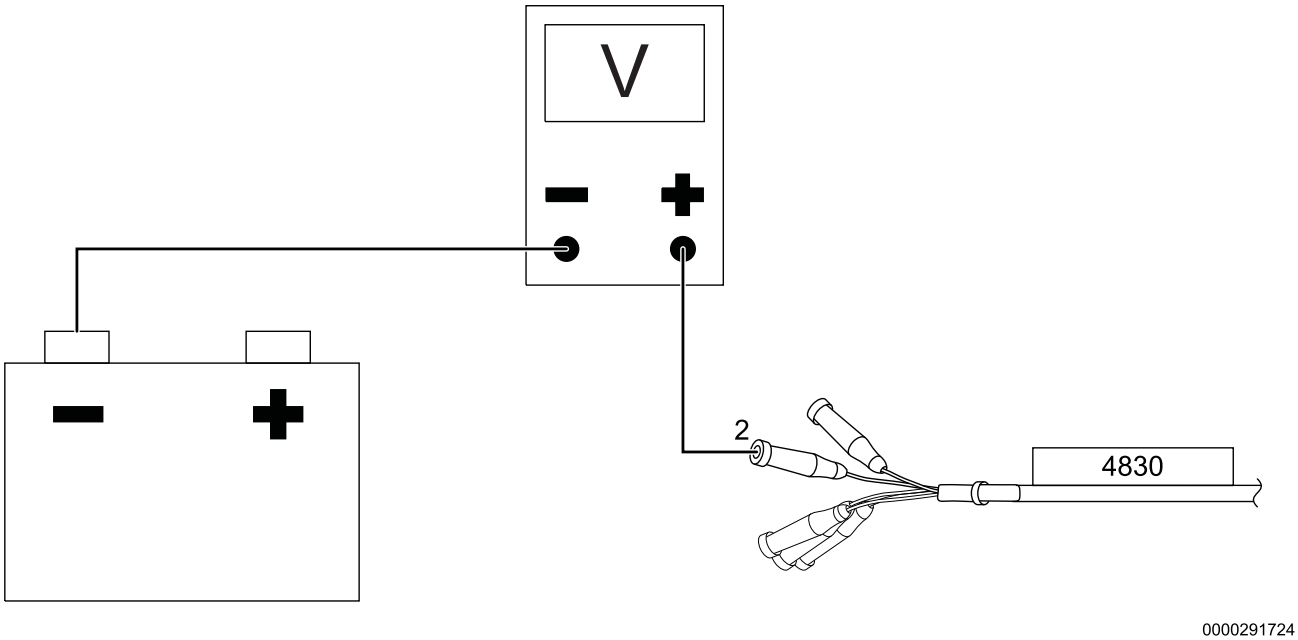
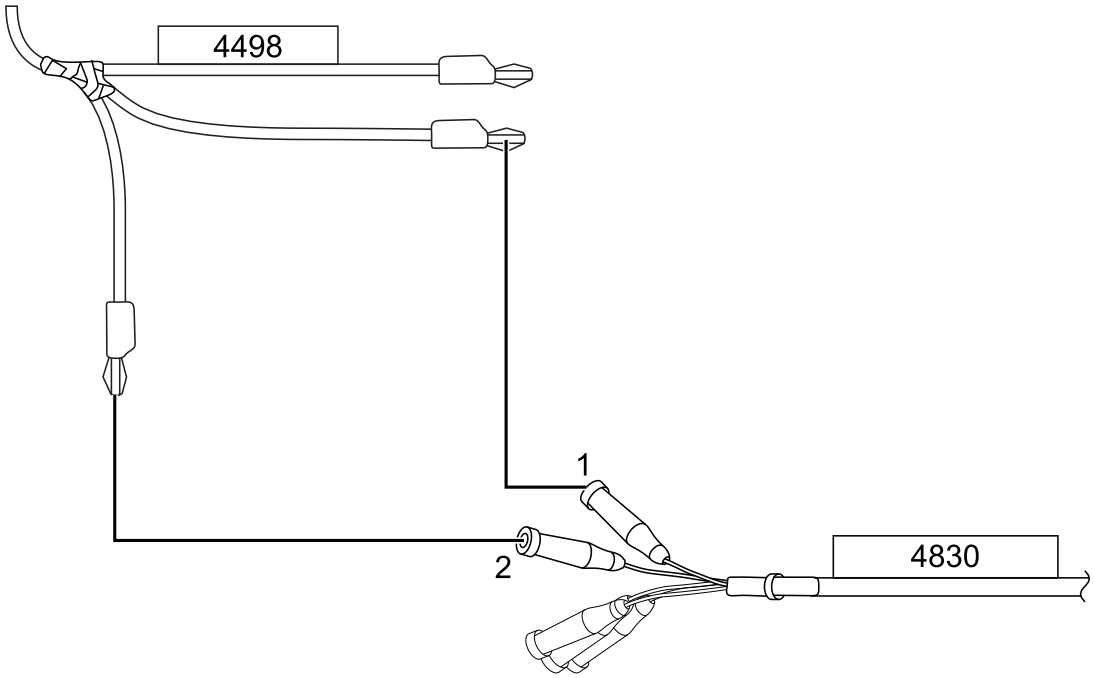


Figure 53 Test 1 AFT: FP1 / AFT: FT Sensor Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4830 to AFT: FP1 / AFT: FT vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-2 and ground (GND).	Greater than 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to power between AFT: FP1 / AFT: FT pin-2 and DCU 86-Pin connector pin-80. After repairs are complete, retest for SPN 5456 FMI 3.
	No: Go to Test 2.



0000304763

Figure 54 Test 2 AFT: FP1 / AFT: FT Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4830 to AFT: FP1 / AFT: FT vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-2 of Breakout Harness ZTSE4830 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 5456 FMI 4 sets in DTC list.
Decision	
Does SPN 5456 FMI 4 set after DTC is cleared?	Yes: Replace AFT: FP1 / AFT: FT sensor. After repairs are complete, retest for SPN 5456 FMI 3.
	No: Go to Test 3.

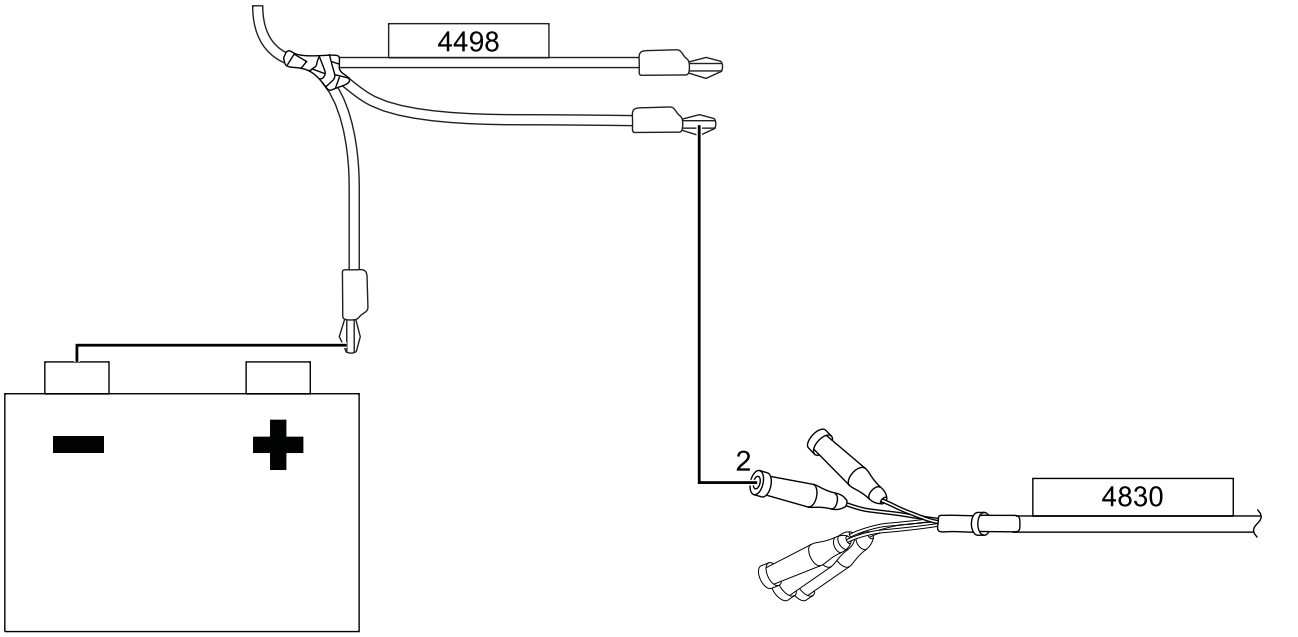


Figure 55 Test 3 AFT: FP1 / AFT: FT Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4435A to AFT: FP1 / AFT: FT vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 to ground (GND). D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector. E. Key-ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 5456 FMI 4 sets in DTC list.
Decision	
Does SPN 5456 FMI 4 set after DTC is cleared?	Yes: Repair Oen in SIG to ground GND circuit. After repairs are complete, retest for SPN 5456 FMI 3.
	No: Repair open in signal circuit. After repairs are complete, retest for SPN 5456 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5456 FMI 3 fault code diagnostics.

SPN 5456 FMI 4 - AFTFT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Fuel Temperature (AFT: FT) sensor signal is less than expected.	AFT: FT voltage < 0.25 volts	Key ON.

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Aftertreatment Fuel Temperature (AFT: FT) sensor is reading less than 0.25 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FT short to GND
- Failed AFT: FP1 / AFT: FT sensor

Step 1	Inspect connections at Aftertreatment Fuel Pressure 1 and Temperature (AFT: FP1 / AFT: FT) sensor connector.	Decision
A. Key OFF. B. Disconnect AFT: FP1/AFT: FT sensor connector. C. Check AFT: FP1/AFT: FT sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP1/AFT: FT sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests (SPN 5456 FMI 4). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5456 FMI 4.

Pin-Point Tests (SPN 5456 FMI 4)

AFT: FP1/ AFT: FT Circuit

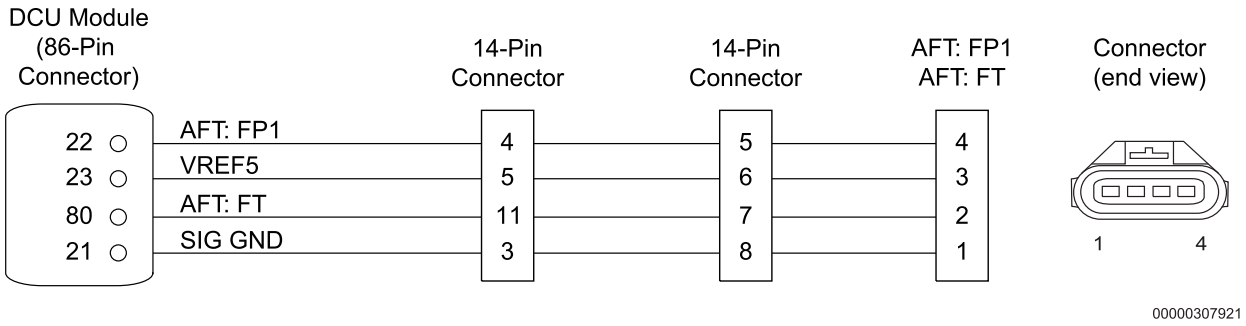


Figure 56 AFT: FP1 / AFT: FT Circuit Diagram

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect AFT: FP1/AFT: FT C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 5456 FMI 3 sets in DTC list.
Decision	
Does SPN 5446 FMI 3 set after DTC is cleared?	Yes: Replace AFT: FT module. After repairs are complete, retest for SPN 5456 FMI 4.
	No: Repair short circuit to ground between pin-2 and DCU pin-80. After repairs are complete, retest for SPN 5456 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5456 FMI 4 fault code diagnostics.

AFT: FP2 (Aftertreatment Fuel Pressure 2) Sensor

Overview of AFT: FP2 Sensor Group

SPN	FMI	Description
3556	0	AFT Fuel Pressure 2 excessively high (Restricted injection) (page 258)
3556	1	AFT Fuel Pressure 2 below desired (Possible system leak) (page 260)
3556	7	AFT Fuel Injector not responding as expected (page 266)
4077	3	AFTFP2 signal Out of Range HIGH (page 268)
4077	4	AFTFP2 signal Out of Range LOW (page 274)

Overview

Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor monitors fuel pressure in aftertreatment fuel system and provides feedback signal to Doser Control Unit (DCU).

SPN 3556 FMI 0 - AFT Fuel Pressure 2 excessively high (Restricted injection)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel System test	Results point to failure of this component This fault code is set if Bit 12 is set to High after completion of systems test (Table D002)	Key ON Battery voltage > 9 Volts AND < 16 Volts System test has run Occurs before a regeneration event (before dosing begins) {when Engine is running}

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Fuel Pressure Control (AFT: FPC) is not responding.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Restricted AFT: DI fuel supply line
- Restricted AFT: DI

Step 1		Decision
Check for restricted or damaged fuel supply line to Aftertreatment Doser Injector (AFT: DI). Is fuel supply line between Down Stream Injection (DSI) module and AFT: DI is in good condition and not restricted?		Yes: Go to Step 2. No: Replace AFT: DI fuel supply line. After repairs are complete, retest for SPN 3556 FMI 0.

Step 2	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a restriction?		Yes: Clean or replace AFT: DI. After repairs are complete, retest for SPN 3556 FMI 0. No: Clear fault and Road Test(page 2236).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3556 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3556 FMI 1 - AFT Fuel Pressure 2 below desired (Possible system leak)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel System test	Results point to failure of this component This fault code is set if Bit 6 is set to High after completion of systems test (Table D002)	Key ON Battery voltage > 9 Volts AND < 16 Volts System test has run Occurs before a regeneration event (before dosing begins) {when Engine is running}

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Fuel Pressure Control (AFT: FPC) is below desired pressure indicating a possible system leak.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3482 (AFT: FEC)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- VREF5 high resistance
- SIG GND high resistance
- AFT: FP2 circuit high resistance
- System Leak
- Failed AFT: FP2

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3482 (AFT: FEC). Is EST DTC list free of SPN 3482?		Yes: Go to Step 2. No: Repair SPN 3482. After repairs are complete, retest for SPN 3556 FMI 1.

Step 2	Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor and connector inspection.	Decision
A. Key OFF. B. Disconnect AFT: FP2 sensor. C. Check AFT: FP2 sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP2 sensor connector, harness, and terminals clean and undamaged?		Yes: Go to pin point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3556 FMI 1.

Step 3	Inspect for system leak between Down Stream Injection (DSI) unit and Aftertreatment Doser Injector (AFT: DI).	Decision
Check DSI module and AFT: DI fuel supply line for damage, restrictions, or leaks. Is fuel supply line and DSI module in good condition and not restricted, leaking, or damaged?		Yes: Go to Step 4. No: Repair or replace damaged or leaking component. After repairs are complete, retest for SPN 3556 FMI 1.

Step 4	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a leak?		Yes: Repair leak. After repairs are complete, retest for SPN 3556 FMI 1. No: Clear fault and Road Test(page 2236).

Pin-Point Tests (SPN 3556 FMI 1)

AFT: FP2 Circuit

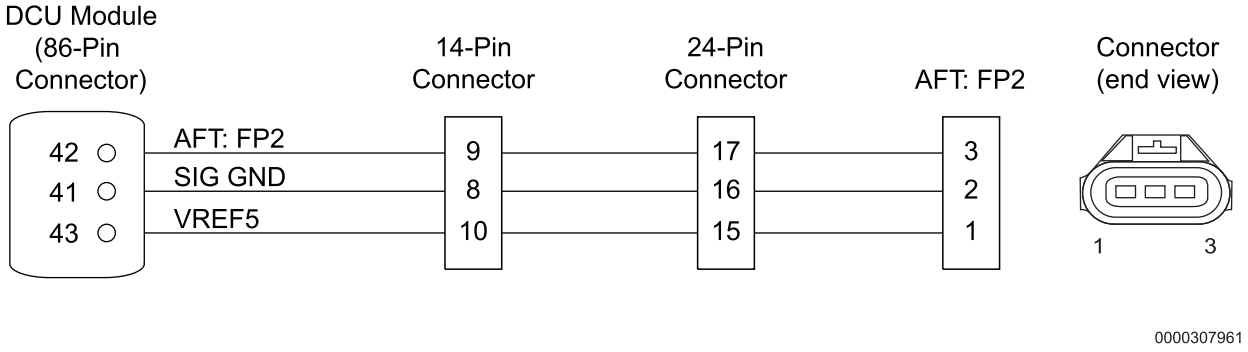
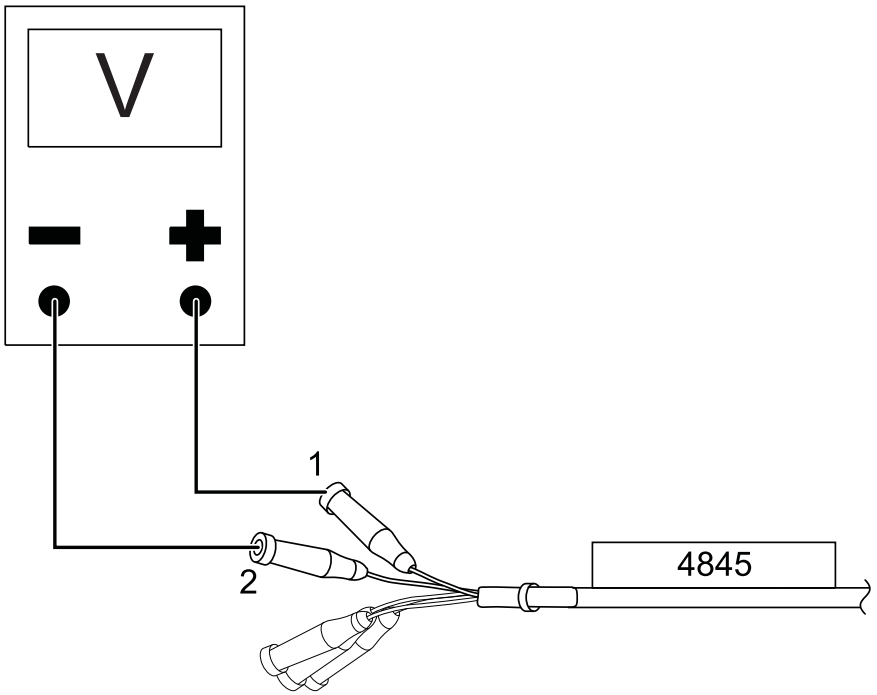


Figure 57 Aftertreatment Fuel Pressure 2 (AFT: FP2) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4845.
- Digital Multimeter (DMM)



0000337261

Figure 58 Test 1: AFT: FP2 Connector Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and pin-1.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Go to Step 3.
	No: Go to Test 2.

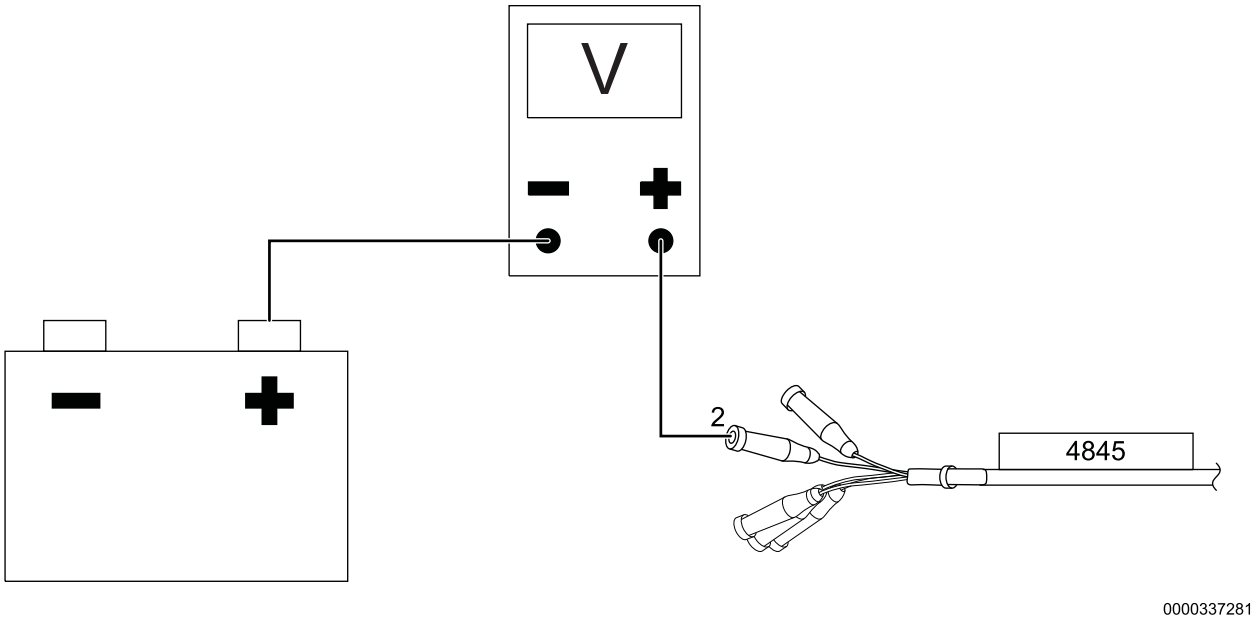


Figure 59 Test 2: AFT: FP2 Connector Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and PWR.	B+ ± 0.25 volts
Decision	
Is voltage B+ ± 0.25 volts?	Yes: Go to Test 3.
	No: Repair high resistance in SIG GND circuit between AFT: FP2 pin-2 and DCU Module pin-41. After repairs are complete, retest for SPN 3556 FMI 1.

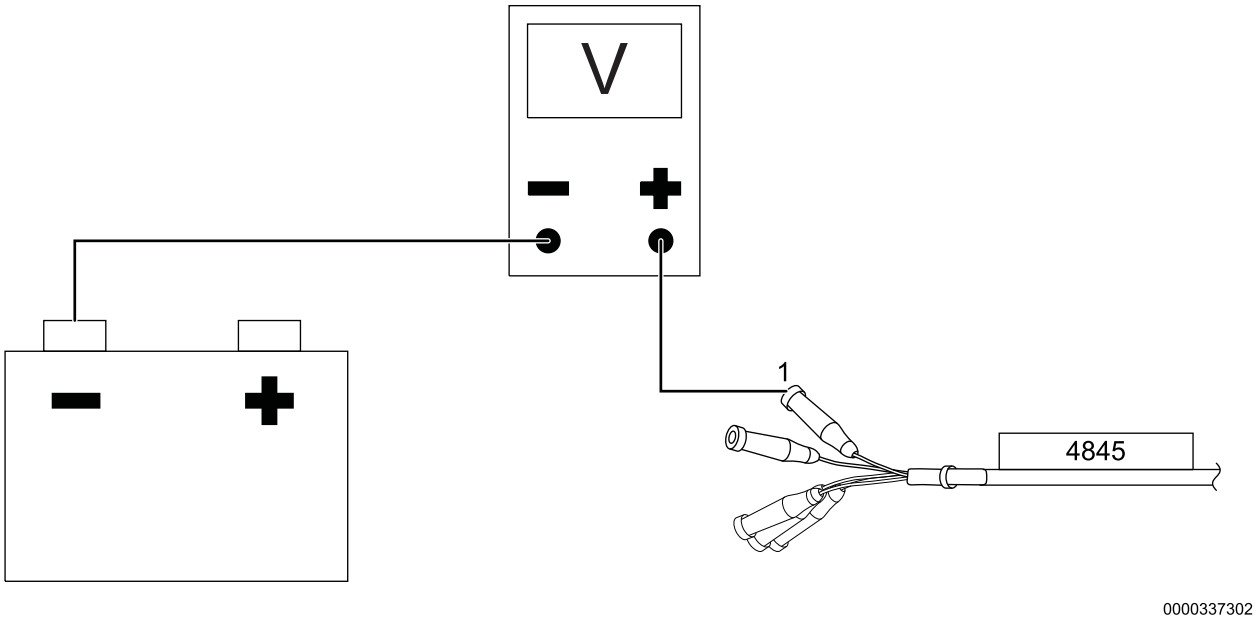


Figure 60 Test 3: AFT: FP2 Connector Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-1 and known good GND.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Replace AFT: FP2 and go to Step 3.
	No: Repair high resistance in VREF5 circuit between AFT: FP2 pin-1 and DCU Module pin-43. After repairs are complete, retest for SPN 3556 FMI 1.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3556 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3556 FMI 7 - AFT Fuel Injector not responding as expected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel System test	If any one of the listed system test is failed three time consecutively This fault code is set if Bit 1, 3, 4, 6, 10, and 12 is set to High after completion of systems test (Table D002).	Key ON Battery voltage > 9 Volts AND < 16 Volts System test has run Occurs before a regeneration event (before dosing begins) {when Engine is running}

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Doser Injector (AFT: DI) is not responding as expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 94 FMI 17 (FDP); SPN 3480 (AFT: FEC); SPN 3482 (AFT: FEC); and SPN 3479 (AFT: FPC)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- System Leak
- Restricted AFT: DI

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 17 (FDP); SPN 3480 (AFT: FEC); SPN 3482 (AFT: FEC); and SPN 3479 (AFT: FPC). Is EST DTC list free of SPN 94 FMI 17; SPN 3480; SPN 3482; and SPN 3479?		Yes: Go to Step 2. No: Repair SPN 94 FMI 17; SPN 3480; SPN 3482; and SPN 3479. After repairs are complete, retest for SPN 3556 FMI 7.

Step 2	Inspect for system leak between Down Stream Injection (DSI) unit and Aftertreatment Doser Injector (AFT: DI).	Decision
Check DSI module and AFT: DI fuel supply line for damage, restrictions, or leaks. Is fuel supply line and DSI module in good condition and not restricted, leaking, or damaged?		Yes: Go to Step 3. No: Repair or replace damaged or leaking component. After repairs are complete, retest for SPN 3556 FMI 7.

Step 3	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a leak?		Yes: Repair leaking or restricted component. After repairs are complete, retest for SPN 3556 FMI 7. No: Clear fault and Road Test(page 2236).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3556 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4077 FMI 3 - AFTFP2 Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Fuel Pressure 2 (AFT: FP2) signal is greater than expected.	AFT: FP2 signal voltage is > 4.75 volts	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that AFT: FP2 signal voltage is greater than 4.75 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3513 FMI 3, 4, and 14 (VREF 5)

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON.

Possible Causes

- AFT: FP2 circuit short to PWR
- AFT: FP2 circuit Open
- SIG GND circuit Open
- Failed AFT: FP2 sensor

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4077 FMI 3. Does EST DTC list show SPN 4077 FMI 3 as Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure(page 2123).

Step 2	Check for associated faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 3513 FMI 3, 4, and 14 (VREF 5). Is EST DTC list free of SPN 3513 FMI 3, 4, and 14?		Yes: Go to Step 3. No: Repair SPN 3512 FMI 3, 4, or 14. After repairs are complete, retest for SPN 4077 FMI 3.

Step 3	Inspect connections at Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor connector.	Decision
A. Key OFF B. Disconnect AFT: FP2 sensor connector. C. Check AFT: FP2 sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the AFT: FP2 sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test (SPN 4077 FMI 3). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4077 FMI 3.

Pin-Point Tests (SPN 4077 FMI 3)

AFT: FP2 Circuit

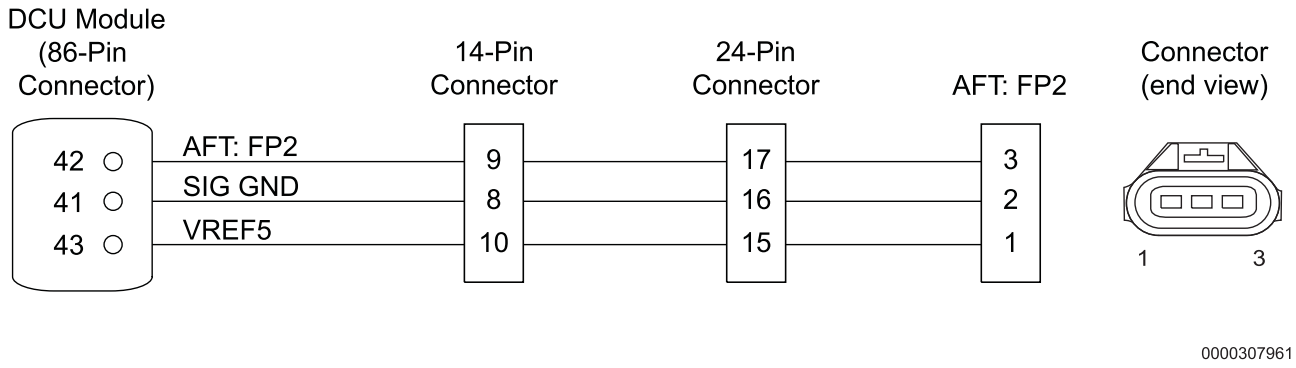


Figure 61 Aftertreatment Fuel Pressure 2 (AFT: FP2) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4498
- Breakout Harness ZTSE6027
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

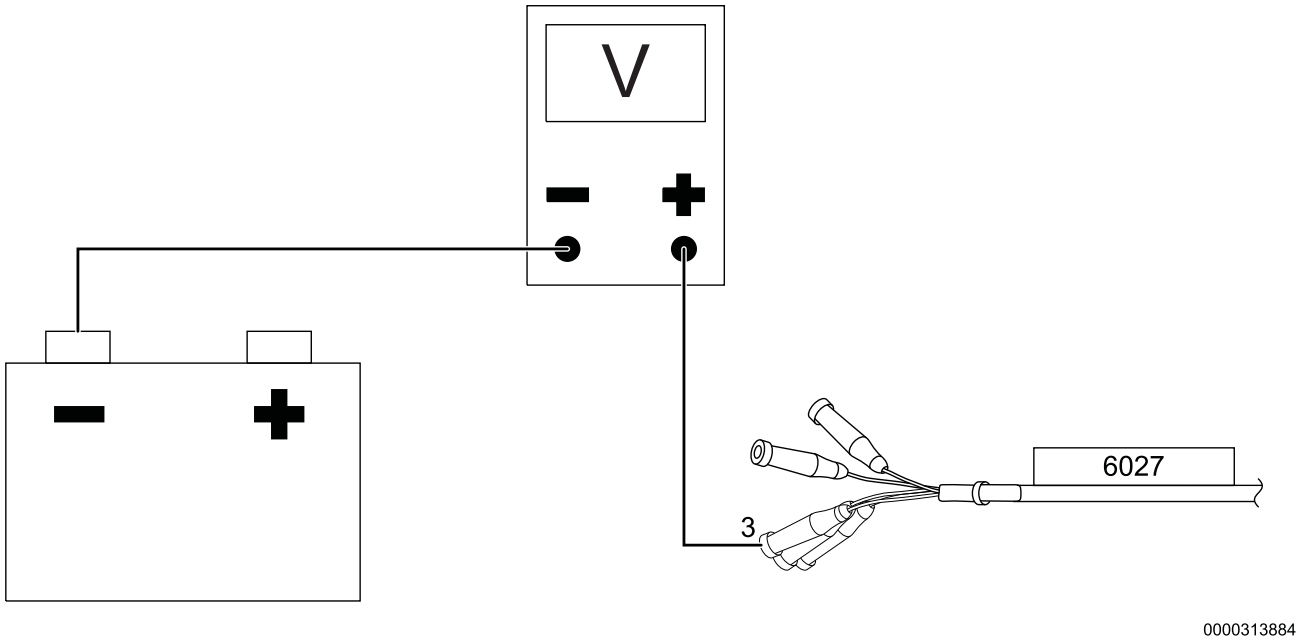
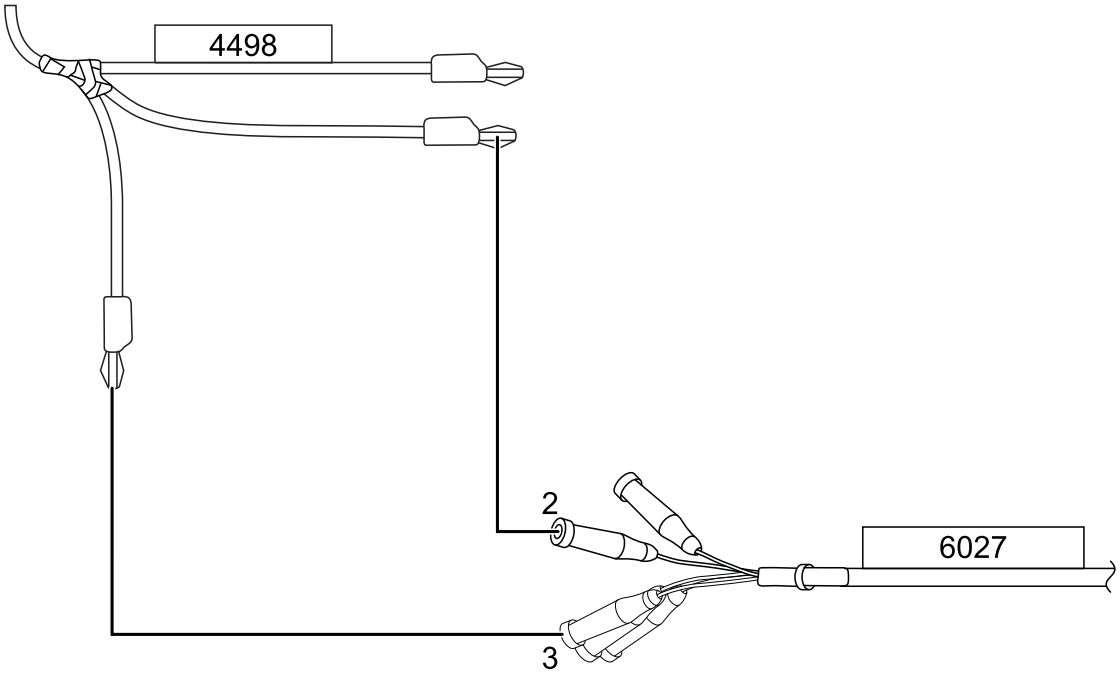


Figure 62 Pin-Point Test 1 AFT: FP2 Sensor Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6027 to Aftertreatment Fuel Pressure 2 (AFT: FP2) vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Use a Digital Multimeter (DMM) to measure voltage between Breakout Harness ZTSE6027 pin-3 and known good ground.	Less than 6 volts
Decision	
Is voltage less than 6 volts?	Yes: Go to Test 2.
	No: Repair short to PWR between AFT: FP2 sensor pin-3 and Doser Control Unit (DCU) pin-42. After repairs are complete, retest for SPN 4077 FMI 3.



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Figure 63 Pin-Point Test 2 AFT: FP2 Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6027 to AFT: FP2 vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE6027 together. D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 4077 FMI 4 sets in DTC list.
Decision	
Does SPN 4077 FMI 4 set after DTC is cleared?	Yes: Replace AFT: FP2 sensor. After repairs are complete, retest for SPN 4077 FMI 3.
	No: Go to Test 3.

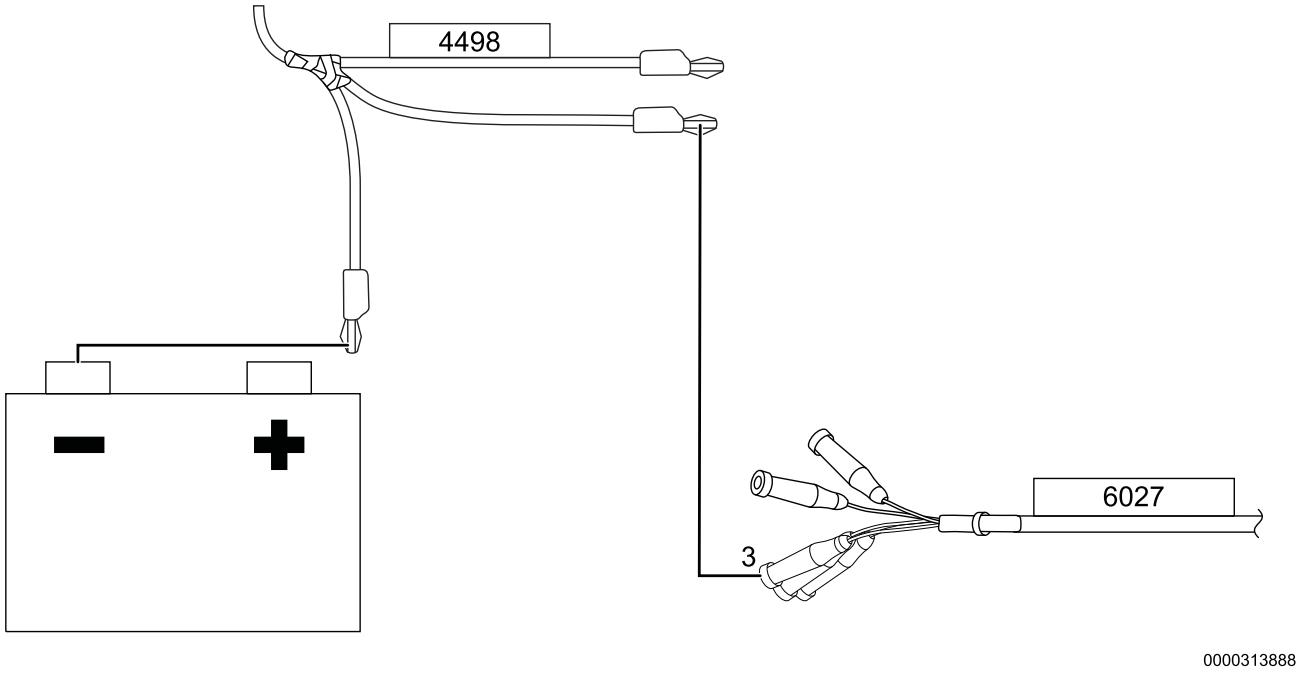


Figure 64 Pin-Point Test 3 AFT: FP2 Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6027 to AFT: FP2 vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-3 of Breakout Harness ZTSE6027 to known good ground. D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector. E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 4077 FMI 4 sets in DTC list.
Decision	
Does SPN 4077 FMI 4 set after DTC is cleared?	Yes: Repair Open between AFT: FP2 sensor pin-2 and DCU pin-41. After repairs are complete, retest for SPN 4077 FMI 3.
	No: Repair Open between AFT: FP2 sensor pin-3 and DCU pin-42. After repairs are complete, retest for SPN 4077 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4077 FMI 3 fault code diagnostics.

SPN 4077 FMI 4 - AFTFP2 Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Fuel Pressure 2 (AFT: FP2) signal is less than expected.	AFT: FP2 signal voltage < 0.25 volt	Key ON.

Fault Overview

Fault code sets when Engine Control Module (ECM) detects AFT: FP2 signal is less than 0.25 volt.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT: FP2 Signal circuit short to GND
- Failed AFT: FP2 sensor
- Voltage VREF5 circuit Open

Step 1	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4077 FMI 4. Does EST DTC list show SPN 4077 FMI 4 as Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor connector	Decision
A. Key OFF. B. Disconnect AFT: FP2 sensor connector. C. Check AFT: FP2 sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the AFT: FP2 sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4077 FMI 4.

Pin-Point Tests (SPN 4077 FMI 4)

AFT: FP2 Circuit

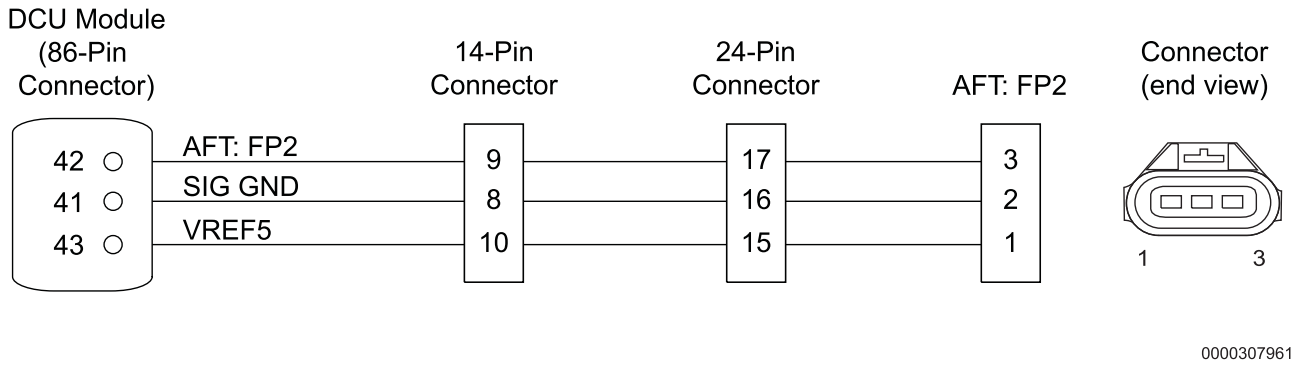


Figure 65 Aftertreatment Fuel Pressure 2 (AFT: FP2) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4830
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

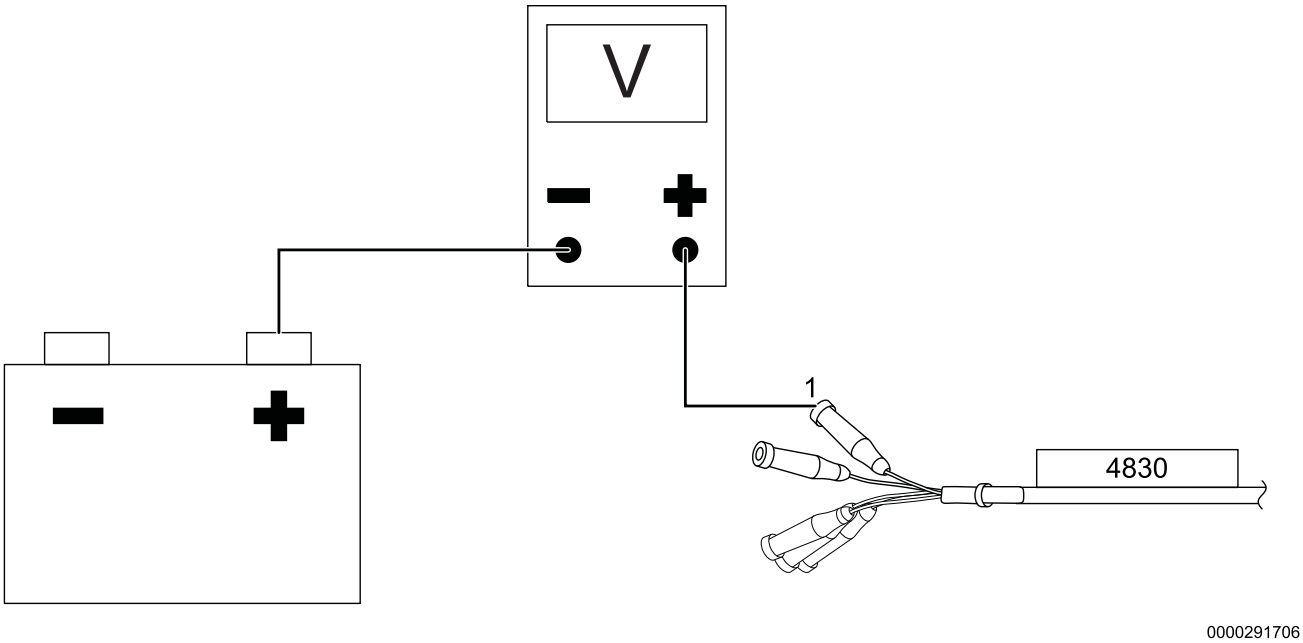


Figure 66 Pin-Point Test 1 AFT: FP2 Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4830 to AFT: FP2 sensor vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Use Digital Multimeter (DMM) to measure voltage between Breakout Harness ZTSE4830 pin-1 and known good ground.	Within 1 volt of 5 volts
Decision	
Is voltage within 1 volt of 5 volts?	Yes: Go to Test 2.
	No: Repair Open between AFT: FP2 connector pin-1 and DCU connector pin-43. After repairs are complete, retest for SPN 4077 FMI 4.

Test 2 Setup
A. Key OFF. B. Disconnect AFT: FP2 sensor connector and leave sensor disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 4077 FMI 3 sets in DTC list.
Decision	
Does SPN 4077 FMI 3 set after DTC is cleared?	Yes: Replace AFT: FP2 sensor. After repairs are complete, retest for SPN 4077 FMI 4.
	No: Repair short to GND between AFT: FP2 sensor connector pin-3 and DCU connector pin-42. After repairs are complete, retest for SPN 4077 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4077 FMI 4 fault code diagnostics.

AFT: FPC (Aftertreatment Fuel Pressure Control) System

Overview of AFT: FPC Sensor

SPN	FMI	Description
3471	1	AFT Fuel Pressure 1 below desired (Low system pressure) (page 280)
3471	7	AFT Fuel Doser Valve not responding as expected (page 286)
3471	10	AFT Fuel Pressure incorrect dosing pressure multiple events (page 292)
3479	3	AFT Fuel Doser Valve Short to PWR (page 298)
3479	4	AFT Fuel Doser Valve Short to GND (page 306)
3479	5	AFT Fuel Pressure Valve Open or Short to GND low side (page 318)
3479	6	AFT Fuel Doser Valve High Side Short circuit (page 328)

Overview

Aftertreatment Fuel Pressure Control (AFT: FPC) is a part of Down Stream Injection (DSI) unit that sends pressurized fuel to Aftertreatment Doser Injector (AFT Doser Injector) to inject fuel into the exhaust pipe.

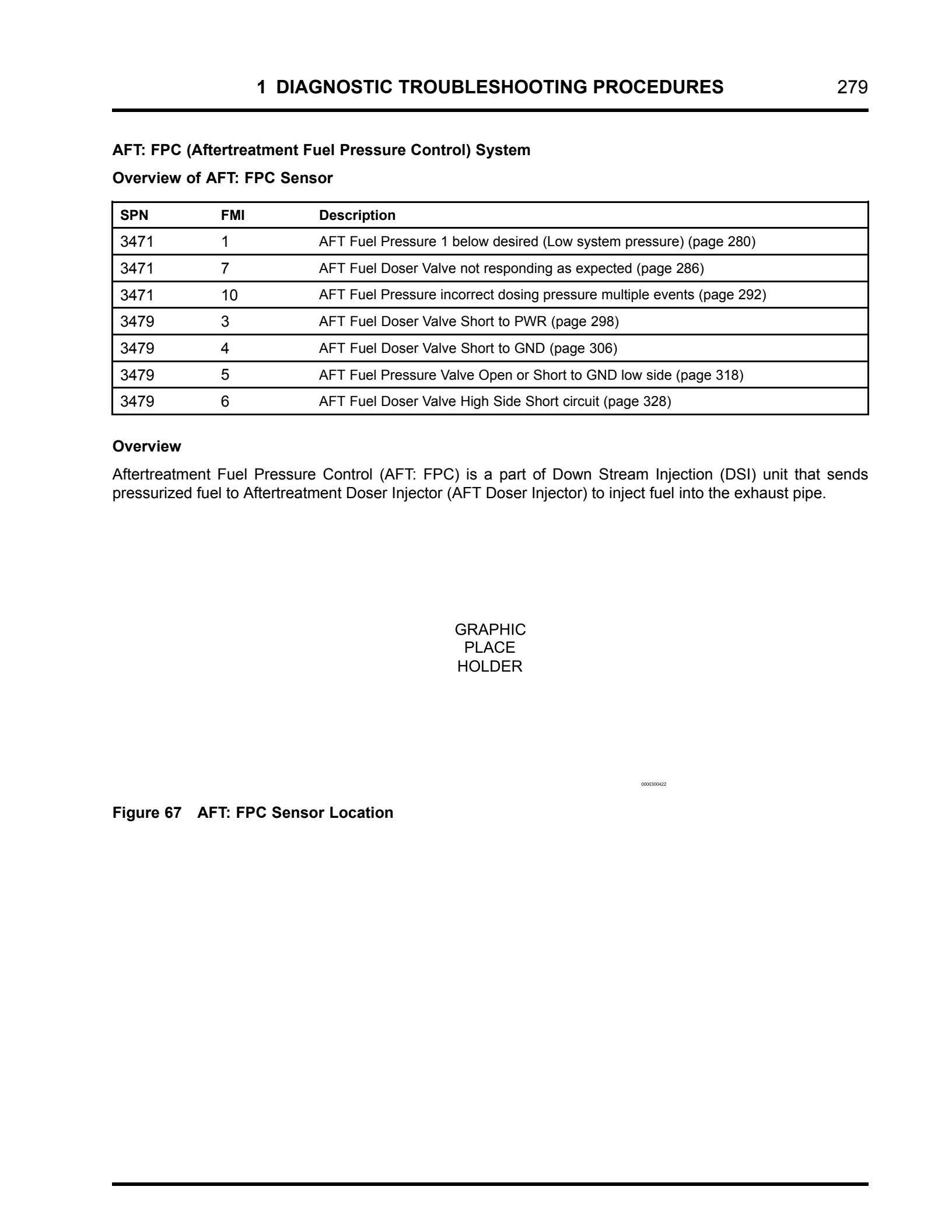


Figure 67 AFT: FPC Sensor Location

SPN 3471 FMI 1 - AFT Fuel Pressure 1 below desired (Low system pressure)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel System test	Results point to failure of this component This fault is set if Bit 1 is set to High AND Bit 5 and Bit 11 is set to Low after systems test. (Table D002)	Key ON Battery voltage > 9 Volts AND < 16 Volts System test has run Occurs before fuel dosing

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Fuel Pressure 1 (AFT: FP1) is below desired pressure.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 94 FMI 17 (FDP)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- VREF 5 high resistance
- SIG GND high resistance
- AFTFP1 circuit high resistance
- System Leak
- Low FDP
- Failed AFTFP1

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 17 (FDP). Is EST DTC list free of SPN 94 FMI 17?		Yes: Go to Step 2. No: Repair SPN 94 FMI 17. After repairs are complete, retest for SPN 3471 FMI 1.

Step 2	Aftertreatment Fuel Pressure 1 (AFT: FP1) sensor and connector inspection.	Decision
A. Key OFF. B. Disconnect AFT: FP1 sensor. C. Check AFT: FP1 sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP1 sensor connector, harness, and terminals clean and undamaged?		Yes: Go to pin point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3471 FMI 1.

Step 3	Inspect for system leak between Electric Fuel Pump (EFP) and Downs Stream Injection (DSI) unit.	Decision
Perform a visual inspection of DSI module and fuel supply line for damage, restrictions, or leaks. Is DSI module fuel supply line in good condition, not restricted, leaking, or damaged?		Yes: Go to Step 4. No: Repair or replace damaged or leaking component. After repairs are complete, retest for SPN 3471 FMI 1.

Step 4	Check Fuel Delivery Pressure (FDP).	Decision
Check for Low Fuel Delivery Pressure(page 120). Is FDP and AFT: FP1 80 psi (552 kPa) or greater?		Yes: Go to Step 5. No: Replace AFT: FP1. After repairs are complete, retest for SPN 3471 FMI 1.

Step 5	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a leak?		Yes: Repair leak. After repairs are complete, retest for SPN 3471 FMI 1. No: Clear fault and Road Test(page 2236).

Pin-Point Tests (SPN 3471 FMI 1)

AFT: FP1/ AFT: FT Circuit

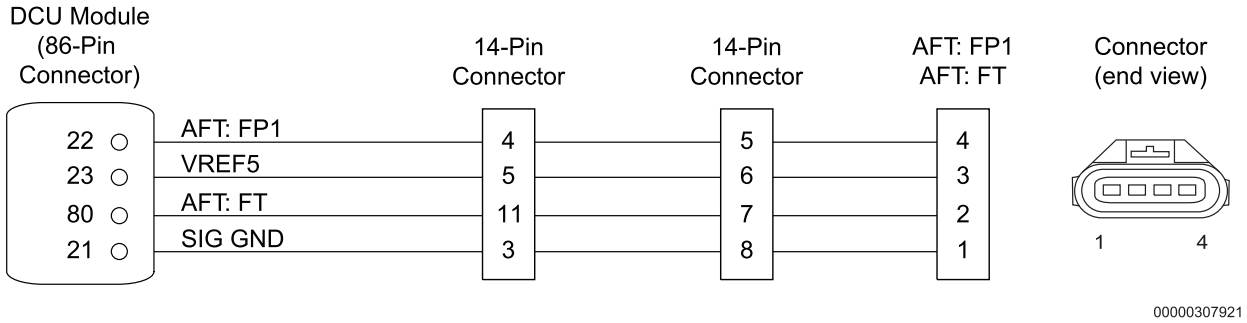
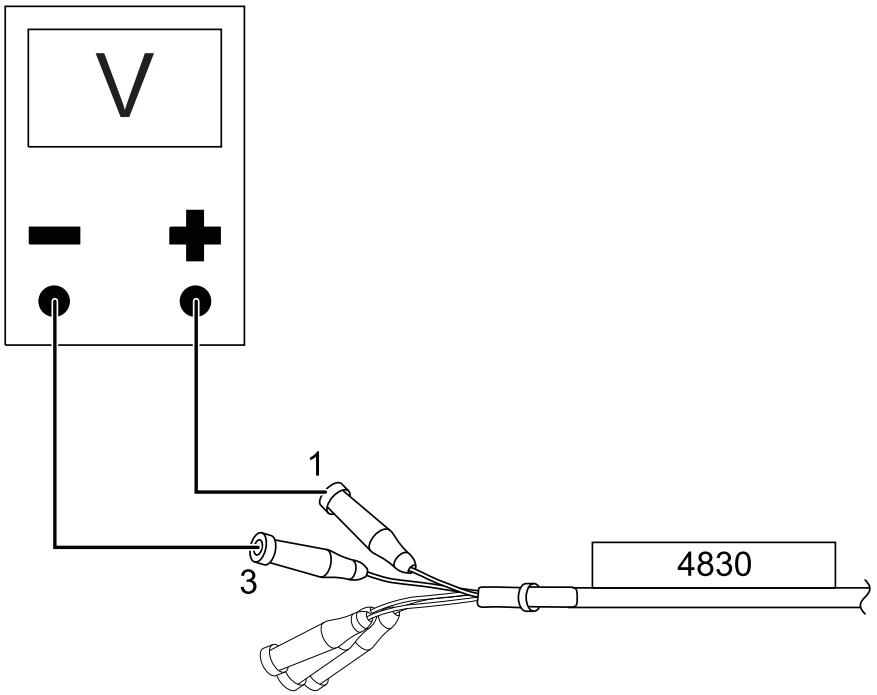


Figure 68 Aftertreatment Fuel Pressure 1 (AFT: FP1) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4830.
- Digital Multimeter (DMM)



0000336481

Figure 69 Test 1: AFT: FP1 Connector Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1). C. Install Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 disconnected. D. Key ON

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-3 and pin-1.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Go to Step 3.
	No: Go to Test 2.

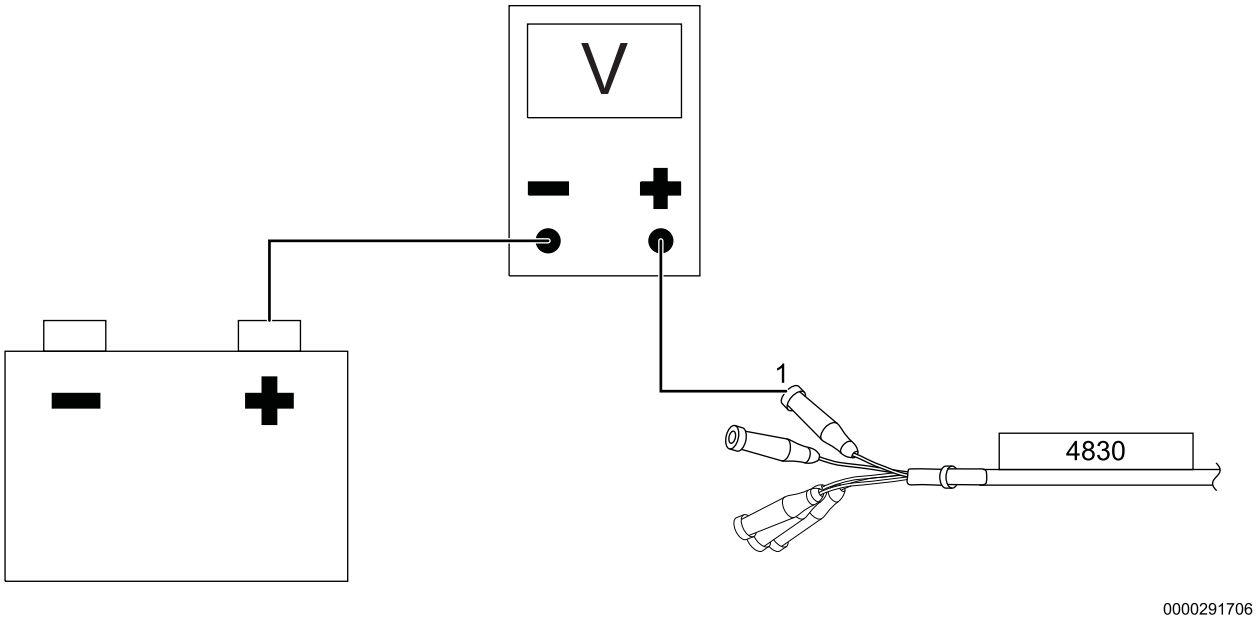


Figure 70 Test 2: AFT: FP1 Connector Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1). C. Install Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 disconnected. D. Key ON

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-1 and PWR.	B+ ± 0.25 volts
Decision	
Is voltage B+ ± 0.25 volts?	Yes: Go to Test 3.
	No: Repair high resistance in SIG GND circuit between AFT: FP1 pin-1 and DCU Module pin-21. After repairs are complete, retest for SPN 3471 FMI 1.

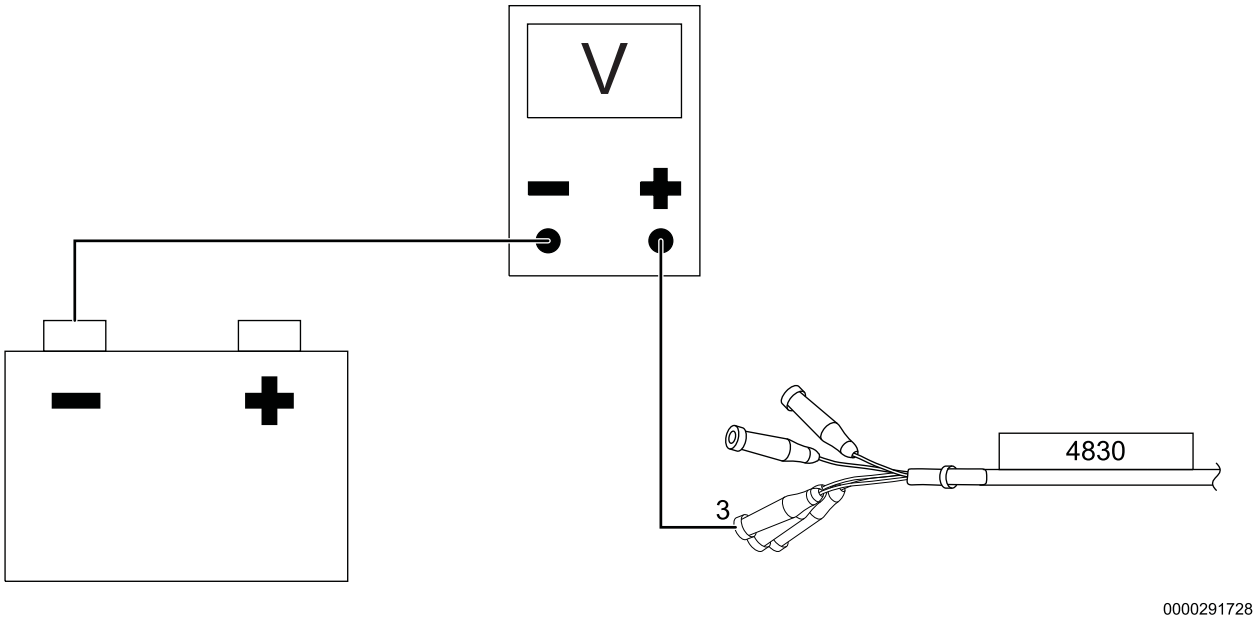


Figure 71 Test 3: AFT: FP1 Connector Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 1 (AFT: FP1). C. Install Breakout Harness ZTSE4830 to vehicle harness and leave AFT: FP1 disconnected. D. Key ON

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-3 and known good GND.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Replace AFT: FP1/AFT: FT unit and go to Step 3.
	No: Repair high resistance in VREF5 circuit between AFT: FP1 pin-3 and DCU Module pin-23. After repairs are complete, retest for SPN 3471 FMI 1.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3471 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3471 FMI 7 - AFT Fuel Doser Valve not responding as expected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Fuel System test	Results point to failure of this component. This fault is set if Bit 4 of the systems test is set to High (Table D002) Results point to failure of this component. This fault is set if Bit 3 of the systems test is set to High (Table D002) Results point to failure of this component. This fault is set if Bit 4 of the systems test is set to High (Table D002)	Key ON Battery voltage > 9 Volts AND < 16 Volts System test has run Occurs before fuel dosing

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Fuel Pressure Control (AFT: FPC) is not responding as expected.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 3556 (AFT: FP2) and SPN 3482 (AFT: FEC)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- VREF5 high resistance
- SIG GND high resistance
- AFT: FP2 circuit high resistance
- System Leak
- Failed AFT: FP2

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3556 (AFT: FP2) and SPN 3482 (AFT: FEC). Is EST DTC list free of SPN 3556 and SPN 3482?		Yes: Go to Step 2. No: Repair SPN 3556 and SPN 3482. After repairs are complete, retest for SPN 3471 FMI 7.

Step 2	Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor and connector inspection.	Decision
A. Key OFF. B. Disconnect AFT: FP2 sensor. C. Check AFT: FP2 sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP2 sensor connector, harness, and terminals clean and undamaged?		Yes: Go to pin point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3471 FMI 7.

Step 3	Inspect for system leak between Down Stream Injection (DSI) unit and Aftertreatment Doser Injector (AFT: DI).	Decision
Check DSI module and AFT: DI fuel supply line for damage, restrictions, or leaks. Is fuel supply line and DSI module in good condition and not restricted, leaking, or damaged?		Yes: Go to Step 4. No: Repair or replace damaged or leaking component. After repairs are complete, retest for SPN 3471 FMI 7.

Step 4	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a leak?		Yes: Repair leak. After repairs are complete, retest for SPN 3471 FMI 7.
		No: Clear fault and Road Test(page 2236).

Pin-Point Tests (SPN 3471 FMI 7)

AFT: FP2 Circuit

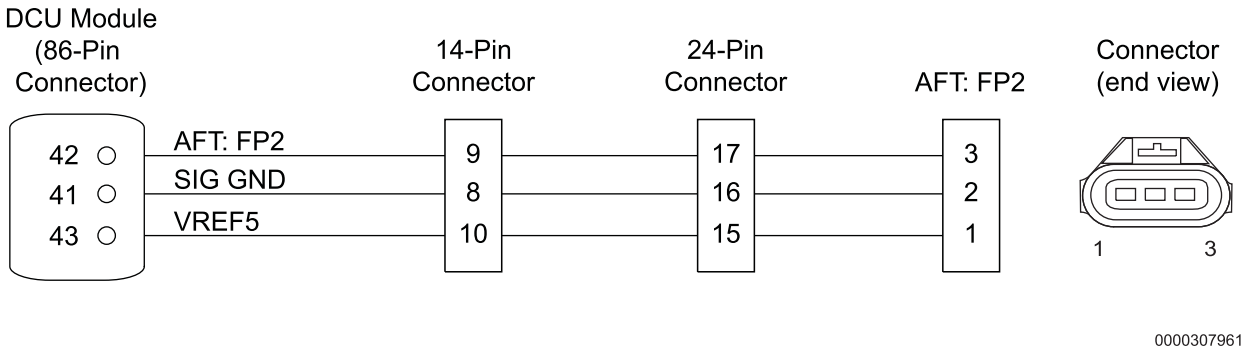
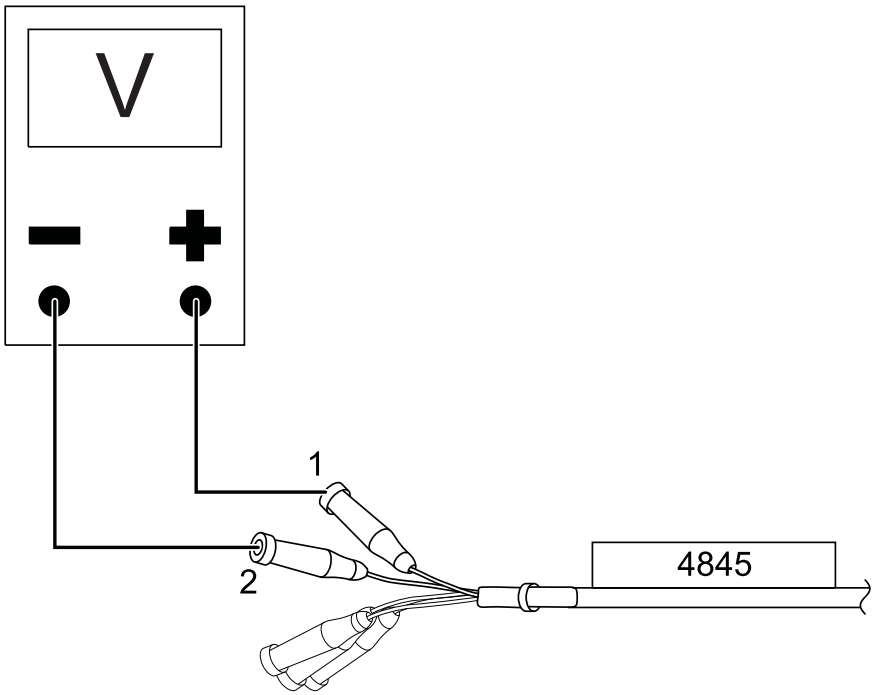


Figure 72 Aftertreatment Fuel Pressure 2 (AFT: FP2) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4845.
- Digital Multimeter (DMM)



0000337261

Figure 73 Test 1: AFT: FP2 Connector Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and pin-1.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Go to Step 3.
	No: Go to Test 2.

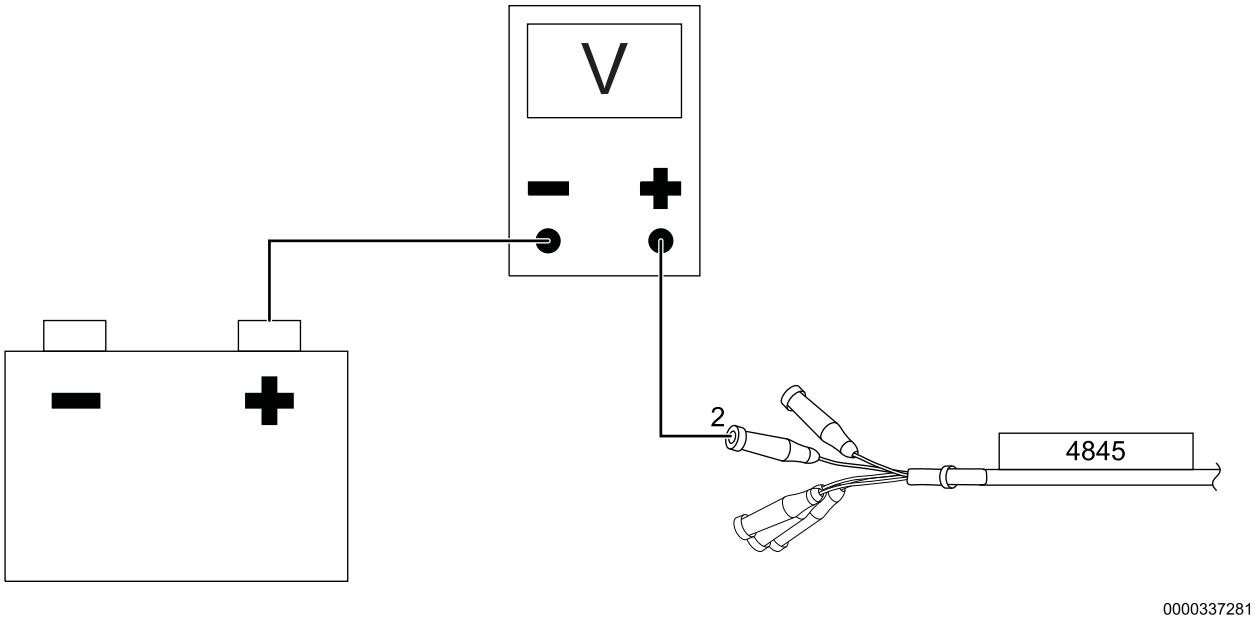


Figure 74 Test 2: AFT: FP2 Connector Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and PWR.	B+ ± 0.25 volts
Decision	
Is voltage B+ ± 0.25 volts?	Yes: Go to Test 3.
	No: Repair high resistance in SIG GND circuit between AFT: FP2 pin-2 and DCU Module pin-41. After repairs are complete, retest for SPN 3471 FMI 7.

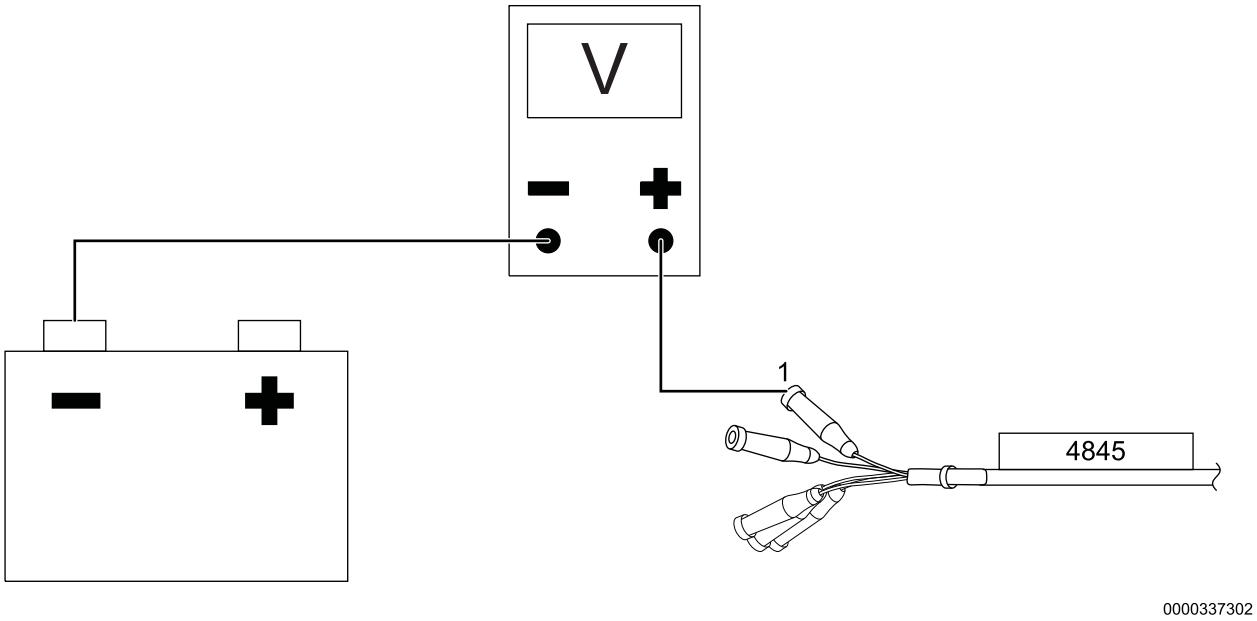


Figure 75 Test 3: AFT: FP2 Connector Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-1 and known good GND.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Replace AFT: FP2 and go to Step 3.
	No: Repair high resistance in VREF5 circuit between AFT: FP2 pin-1 and DCU Module pin-43. After repairs are complete, retest for SPN 3471 FMI 7.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3471 FMI 7 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3471 FMI 10 - AFT Fuel Pressure incorrect dosing pressure multiple events

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
AFT Fuel Doser Valve abnormal rate of change	TBD	TBD

Fault Overview

Fault sets when Aftertreatment Control Module (ACM) detects Aftertreatment Fuel Pressure Control (AFT: FPC) has an abnormal rate of change.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3556 (AFT: FP2) and SPN 3482 (AFT: FEC)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- VREF5 high resistance
- SIG GND high resistance
- AFT: FP2 circuit high resistance
- System Leak
- Failed AFT: FP2

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3556 (AFT: FP2) and SPN 3482 (AFT: FEC). Is EST DTC list free of SPN 3556 and SPN 3482?		Yes: Go to Step 2. No: Repair SPN 3556 and SPN 3482. After repairs are complete, retest for SPN 3471 FMI 10.

Step 2	Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor and connector inspection.	Decision
A. Key OFF. B. Disconnect AFT: FP2 sensor. C. Check AFT: FP2 sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FP2 sensor connector, harness, and terminals clean and undamaged?		Yes: Go to pin point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3471 FMI 10.

Step 3	Inspect for system leak between Down Stream Injection (DSI) unit and Aftertreatment Doser Injector (AFT: DI).	Decision
Check DSI module and AFT: DI fuel supply line for damage, restrictions, or leaks. Is fuel supply line and DSI module in good condition and not restricted, leaking, or damaged?		Yes: Go to Step 4. No: Repair or replace damaged or leaking component. After repairs are complete, retest for SPN 3471 FMI 10.

Step 4	Check for Down Stream Injection (DSI) system leaks.	Decision
Perform KOER DSI System Test(page 2187) to check the DSI system for leaks. Does DSI system test indicate a leak?		Yes: Repair leak. After repairs are complete, retest for SPN 3471 FMI 10. No: Clear fault and Road Test(page 2236).

Pin-Point Tests (SPN 3471 FMI 10)

AFT: FP2 Circuit

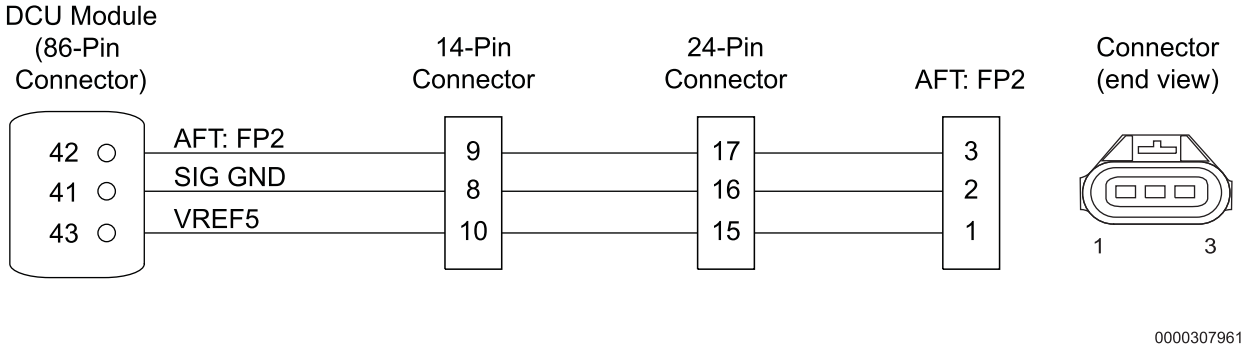
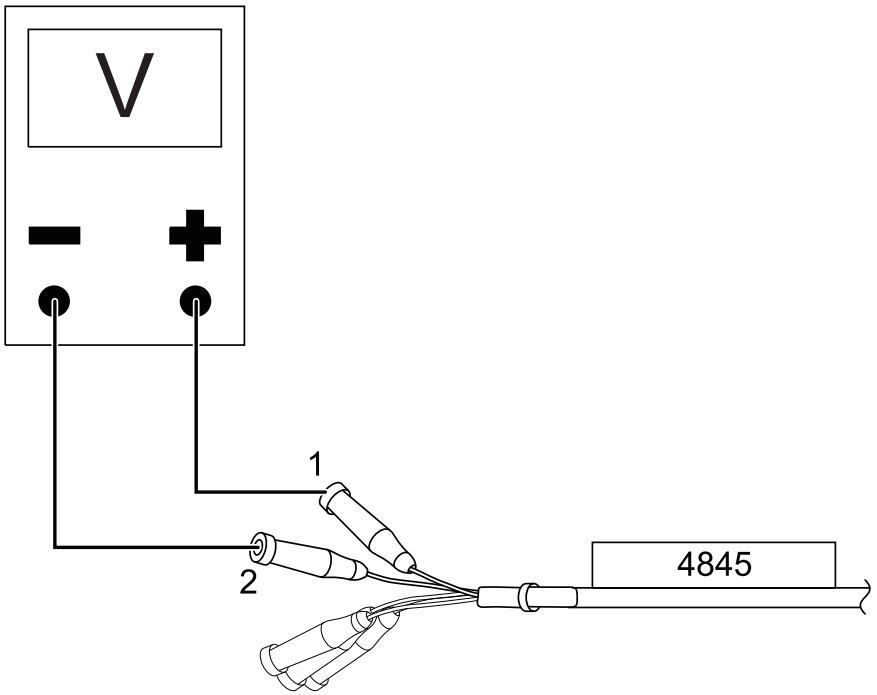


Figure 76 Aftertreatment Fuel Pressure 2 (AFT: FP2) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4845.
- Digital Multimeter (DMM)



0000337261

Figure 77 Test 1: AFT: FP2 Connector Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and pin-1.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Go to Step 3.
	No: Go to Test 2.

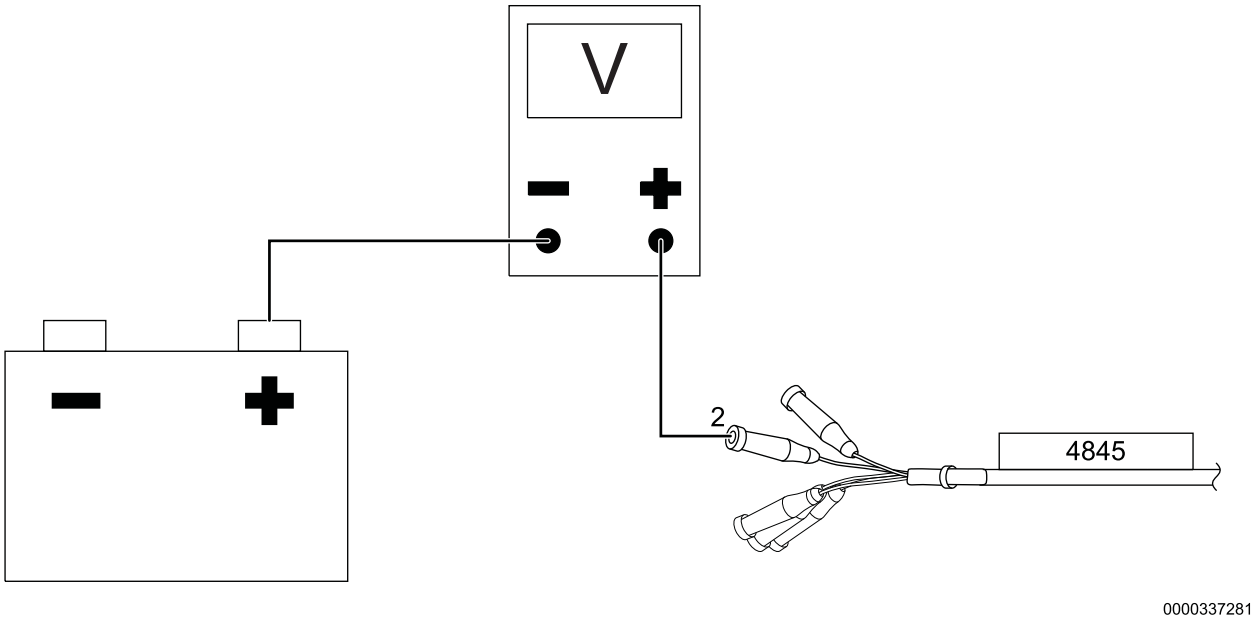


Figure 78 Test 2: AFT: FP2 Connector Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4845 pin-2 and PWR.	B+ ± 0.25 volts
Decision	
Is voltage B+ ± 0.25 volts?	Yes: Go to Test 3.
	No: Repair high resistance in SIG GND circuit between AFT: FP2 pin-2 and DCU Module pin-41. After repairs are complete, retest for SPN 3471 FMI 10.

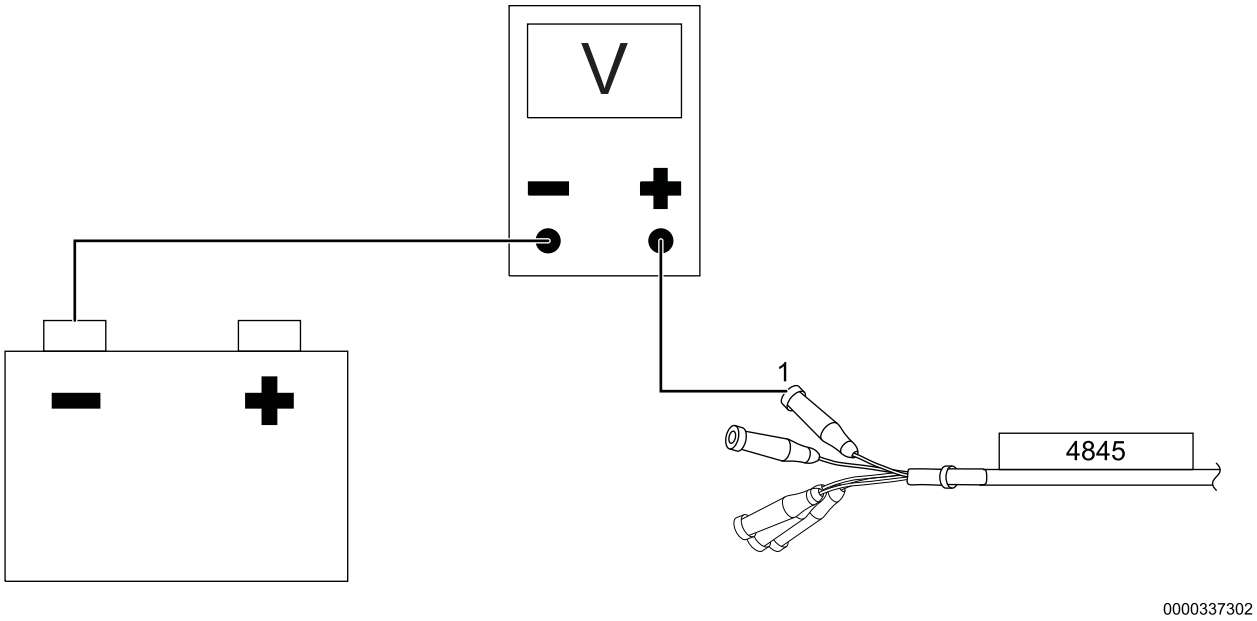


Figure 79 Test 3: AFT: FP2 Connector Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure 2 (AFT: FP2). C. Install Breakout Harness ZTSE4845 to vehicle harness and leave AFT: FP2 disconnected. D. Key ON

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4830 pin-1 and known good GND.	5 ± 0.1 volts
Decision	
Is voltage 5 ± 0.1 volts?	Yes: Replace AFT: FP2 and go to Step 3.
	No: Repair high resistance in VREF5 circuit between AFT: FP2 pin-1 and DCU Module pin-43. After repairs are complete, retest for SPN 3471 FMI 10.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3471 FMI 10 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3479 FMI 3 - AFT Fuel Doser Valve Short to PWR

Condition / Description	Setting Criteria	Pressure Conditions / Condition Values
Short to Power Low Side.	Circuit voltage > 0.3 volts	Key ON Battery voltage > 9 volts and < 16 volts

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects a short to PWR on low side driver circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Doser Control Unit (DCU) deactivates circuits when a circuit fault is present, so NOID lamp is needed to simulate correct circuit. Fault is latched for a key cycle, so Engine Control Module (ECM) must be reset by a Key OFF cycle.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in AFT: FPC-L circuit
- Open in AFT: FPC-H circuit
- Failed AFT: FPC

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF and wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156).		Yes: Go to Step 2.
Is EST DTC list SPN 3479 FMI 3 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Check vehicle harness / NOID Lamp illumination.	Decision
A. Key OFF. B. Connect NOID Lamp 15-909-01 to vehicle harness and leave AFT: FPC disconnected. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156).		Yes: Replace AFT: FPC. After repairs are complete, retest for SPN 3479 FMI 3.
Did NOID Lamp illuminate?		No: Go to Step 3.

Step 3	Inspect connections at 24-Pin Engine to Chassis connector.	Decision
A. Key OFF.		Yes: Go to Step 4.
B. Disconnect 24-Pin Engine to Chassis connector. C. Check 24-Pin Engine to Chassis connectors and connector terminals for damaged or pinched wires; wet and corroded terminals; loose, bent, or broken pins; or broken connector housings.		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 3.
Are 24-Pin Engine to Chassis connectors, harnesses, and terminals clean and undamaged?		

Step 4	Inspect 14-Pin DCU Jumper Harness connections.	Decision
A. Key OFF.		Yes: Perform Pin-Point Tests .
B. Disconnect 86-Pin DCU connector. C. Check 86-Pin DCU connector and connector terminals for damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housings.		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 3.
Are 14-Pin DCU Jumper Harness connector, harness, and terminals clean and undamaged?		

Pin-Point Tests (SPN 3479 FMI 3)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- NOID Lamp 15-909-01
- Breakout Harness (24-Pin) ZTSE6020
- Breakout Harness (AFT: FPC) ZTSE6021
- Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM)

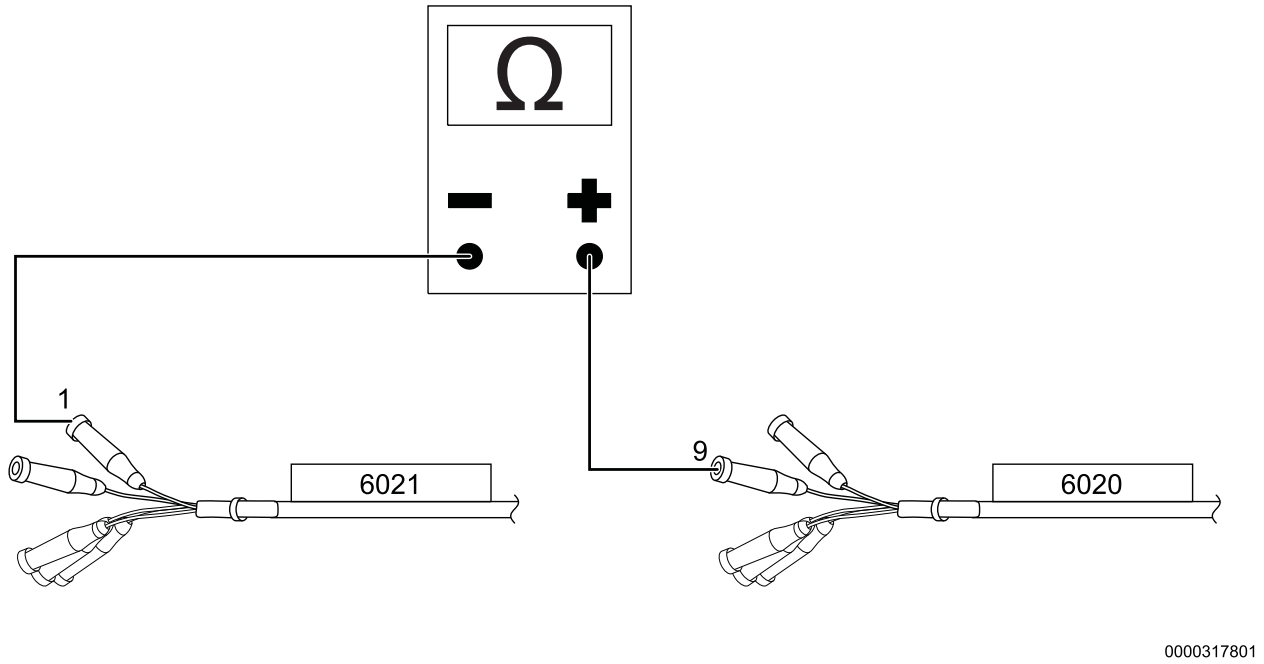


Figure 80 Test 1 AFT: FPC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect AFT: FPC connector. C. Disconnect 24-Pin Engine to Chassis connector. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis disconnected. E. Connect Breakout Harness ZTSE6021 to vehicle harness and leave AFT: FPC disconnected. F. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and Breakout Harness ZTSE6020 pin-9.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 2.
	No: Repair Open in AFT: FPC circuit between AFT: FPC pin-1 and 24-Pin Engine to Chassis pin-9. After repairs are complete, retest for SPN 3479 FMI 3.

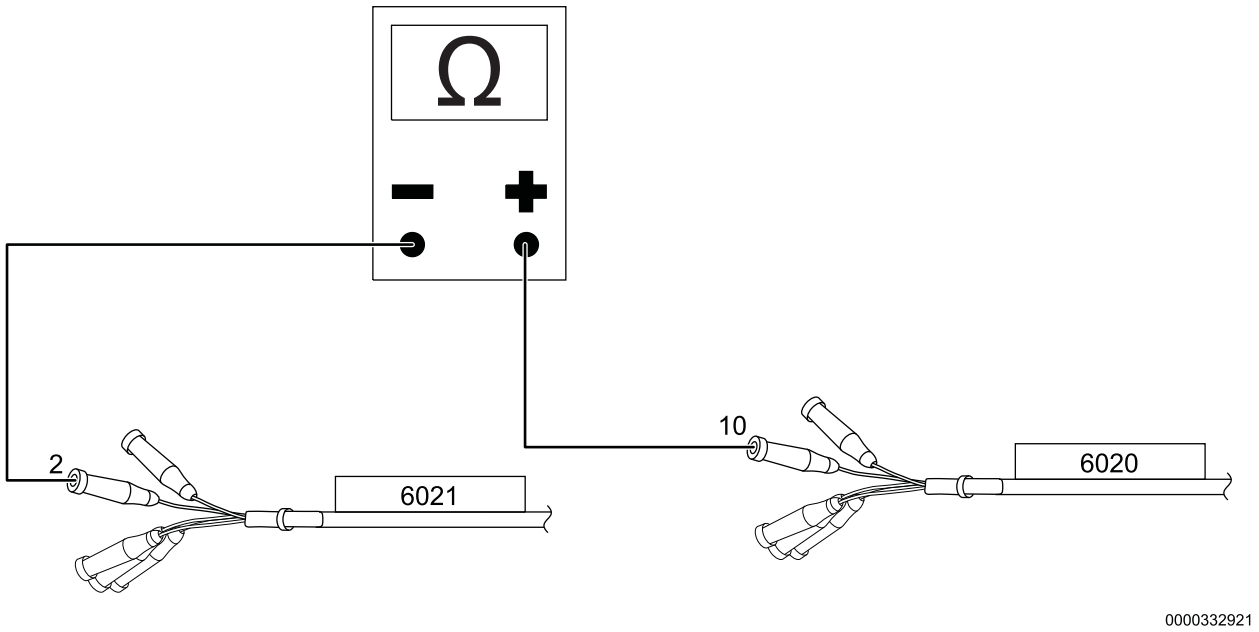


Figure 81 Test 2 AFT: FPC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect AFT: FPC connector. C. Disconnect 24-Pin Engine to Chassis connector. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis disconnected. E. Connect Breakout Harness ZTSE6021 to vehicle harness and leave AFT: FPC disconnected. F. Key ON.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and Breakout Harness ZTSE6020 pin-10.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 2.
	No: Repair Open in AFT: FPC circuit between AFT: FPC pin-2 and 24-Pin Engine to Chassis pin-10. After repairs are complete, retest for SPN 3479 FMI 3.

Test 3 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Disconnect 14-Pin DCU jumper harness connector. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis disconnected. E. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-6 and leave 14-Pin DCU jumper harness connector disconnected. F. Key ON.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-9 and 14-Pin DCU jumper harness connector pin-6.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 4.
	No: Repair Open in AFT: FPC circuit between 24-Pin Engine to Chassis connector pin-9 and 14-Pin DCU jumper harness connector pin-6. After repairs are complete, retest for SPN 3479 FMI 3.

Test 4 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Disconnect 14-Pin DCU jumper harness connector. D. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis disconnected. E. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-1 and leave 14-Pin DCU jumper harness connector disconnected. F. Key ON.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-10 and 14-Pin DCU jumper harness connector pin-1.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 5.
	No: Repair Open in AFT: FPC circuit between 24-Pin connector pin-10 and 14-Pin DCU jumper harness connector pin-1. After repairs are complete, retest for SPN 3479 FMI 3.

Test 5 Setup
A. Key OFF. B. Disconnect 86-Pin DCU connector. C. Disconnect 14-Pin DCU jumper harness connector. D. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-30 and leave 86-Pin DCU connector disconnected. E. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-6 and leave 14-Pin DCU jumper harness connector disconnected. F. Key ON.

Test 5	Specification
Use DMM to measure resistance between 86-Pin DCU terminal test pin-30 and 14-Pin DCU jumper harness terminal test pin-6.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open in AFT: FPC-L circuit. After repairs are complete, retest for SPN 3479 FMI 3.
	No: Repair Open in AFT: FPC-H circuit. After repairs are complete, retest for SPN 3479 FMI 3.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3479 FMI 3 fault code diagnostics.

SPN 3479 FMI 4 - AFT Fuel Doser Valve Short to GND

Condition / Description	Setting Criteria	Pressure Conditions / Condition Values
Short to ground on High side	High-side circuit current > 8.82 Amps	Key ON Battery voltage > 9 volts and < 16 volts

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects a short to ground on high-side circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Doser Control Unit (DCU) deactivates circuits when a circuit fault is present, so NOID lamp is needed to simulate correct circuit. Fault is latched for a key cycle, so Engine Control Module (ECM) must be reset by a Key OFF cycle.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DCU circuit fault
- Failed Aftertreatment Fuel Pressure Control (AFT: FPC)

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF and wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics(page 2156). Is EST Diagnostic Trouble Code (DTC) list SPN 3479 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
A. Key OFF. B. Disconnect AFT: FPC connector. C. Check AFT: FPC connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FPC connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 4.

Step 3	Check vehicle harness / NOID lamp illumination.	Decision
A. Key OFF. B. Connect NOID lamp to vehicle harness and leave AFT: FPC disconnected. C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics(page 2156). Did NOID light illuminate?		Yes: Replace AFT: FPC. After repairs are complete, retest for SPN 3479 FMI 4. No: Perform Pin-Point Tests .

Step 4	Inspect connections at 86-pin Doser Control Unit (DCU).	Decision
A. Key OFF. B. Disconnect DCU. C. Check DCU and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing. Are 86-pin DCU connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests(page 316). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 4.

Pin-Point Tests (SPN 3479 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6020
- Breakout Harness ZTSE6021
- Digital Multimeter (DMM)
- Terminal Test Kit ZTSE4435C

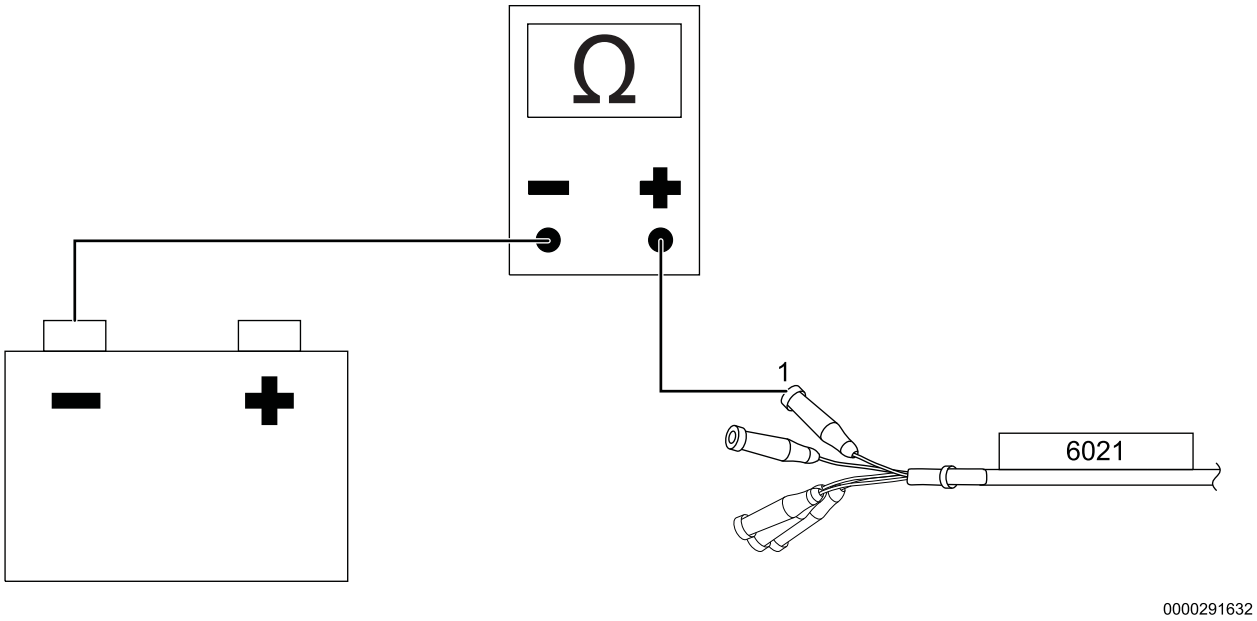


Figure 82 Test 1 AFT: FPC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Go to Test 2.

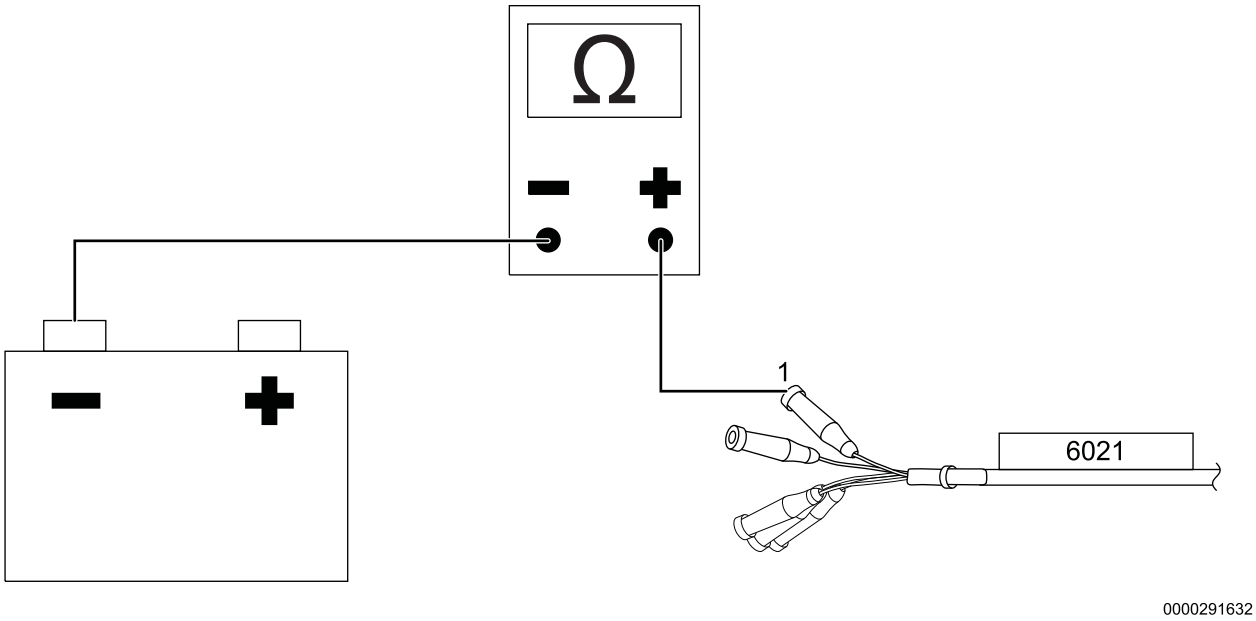


Figure 83 Test 2 AFT: FPC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected. C. Disconnect 24-pin engine to chassis connector.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin engine to chassis connector pin-9 and Doser Control Unit (DCU) pin-30. After repairs are complete, retest for SPN 3479 FMI 4.
	No: Repair short to ground between 24-pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 4.

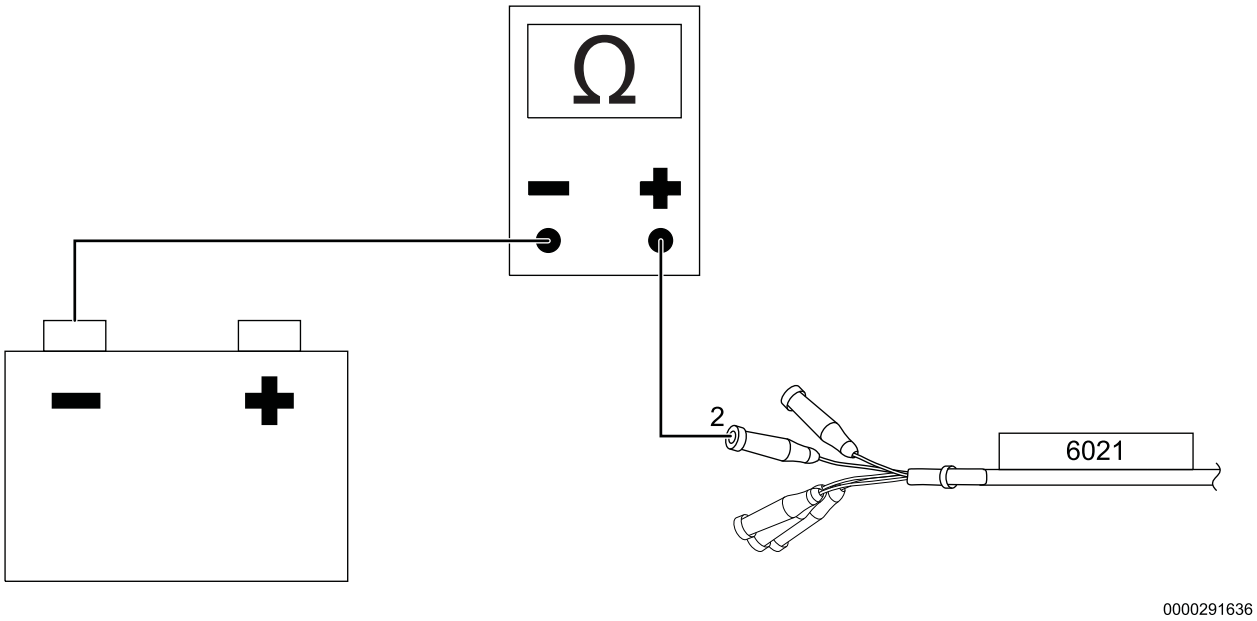


Figure 84 Test 3 AFT: FPC Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Go to Test 4.

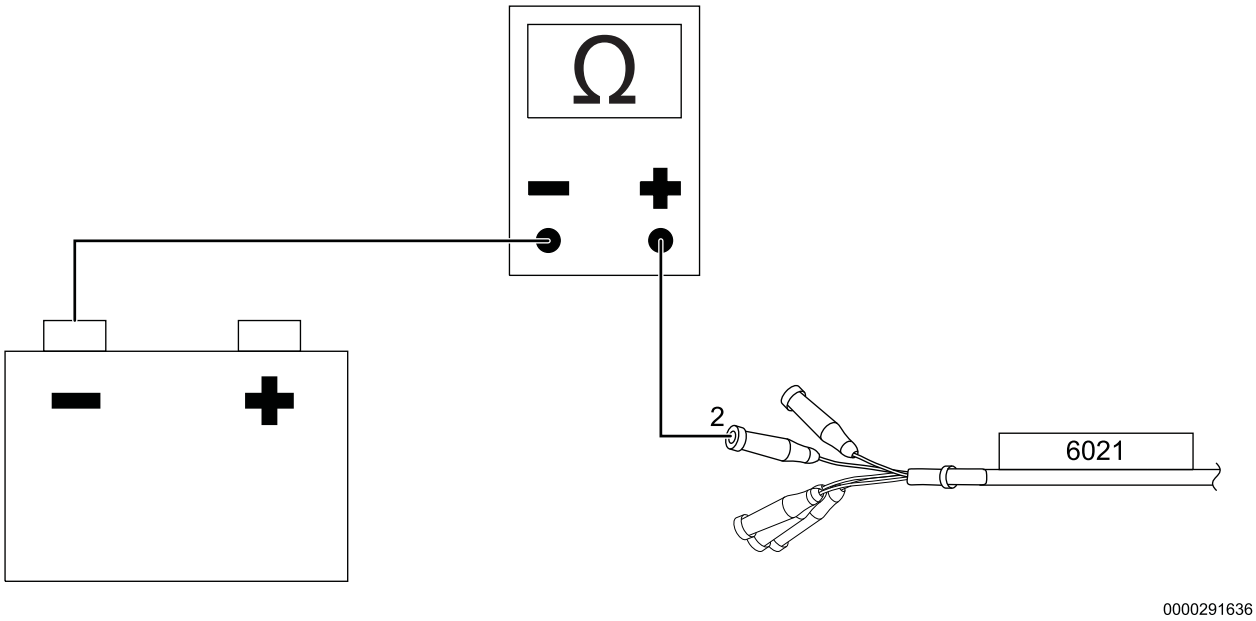


Figure 85 Test 4 AFT: FPC Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected. C. Disconnect 24-pin engine to chassis connector

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 4.
	No: Repair short to ground between 24-pin engine to chassis connector pin-10 and Aftertreatment Fuel Pressure Control (AFT: FPC) pin-2. After repairs are complete, retest for SPN 3479 FMI 4.

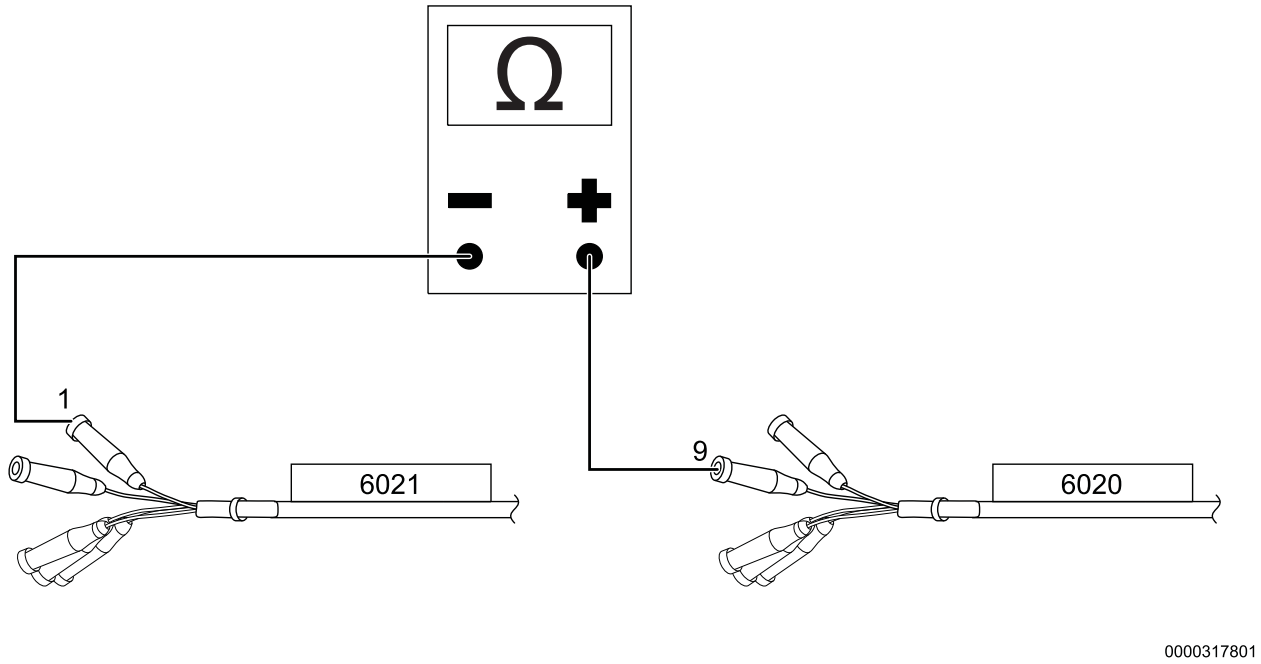


Figure 86 Test 5 AFT: FPC Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected. C. Connect Breakout Harness ZTSE6020 to engine side of 24-pin engine and chassis connector and leave chassis side disconnected.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and Breakout Harness ZTSE6020 pin-9.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Diagnostic Step 4 (page 307).
	No: Repair Open between 24-pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 4.

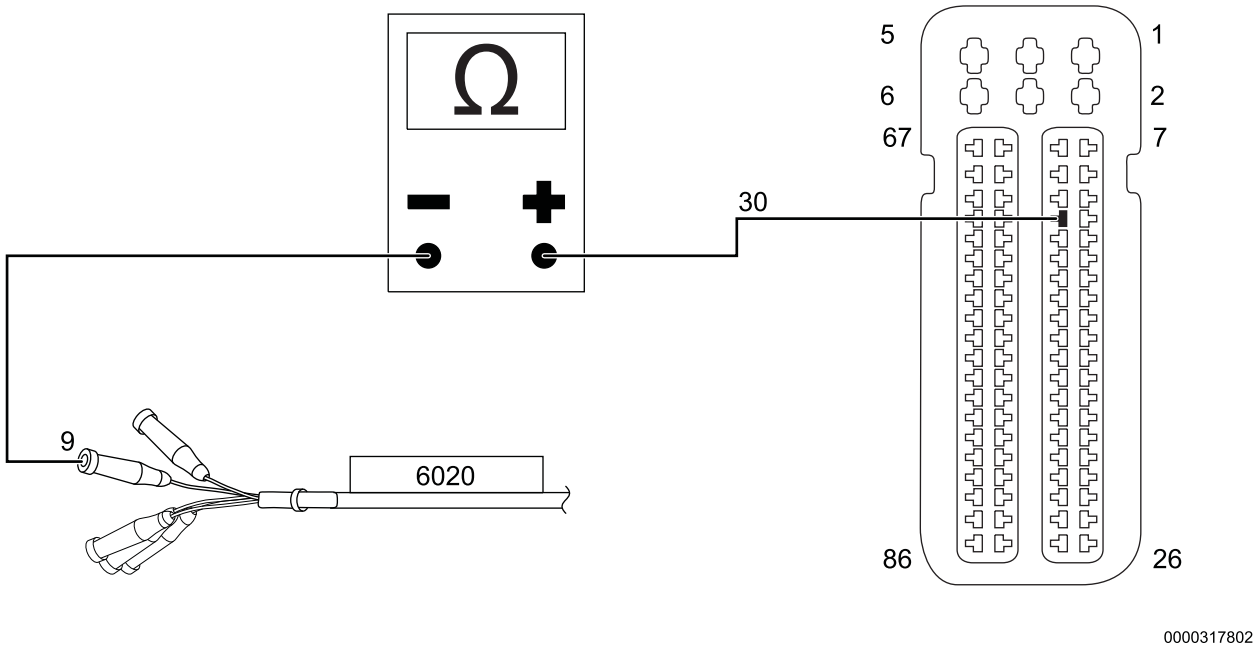


Figure 87 Test 6 AFT: FPC Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into Doser Control Unit (DCU) 86-pin connector pin-30.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-9 and DCU pin-30.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7.
	No: Repair Open between 24-pin engine to chassis connector pin-9 and DCU pin-30. After repairs are complete, retest for SPN 3479 FMI 4.

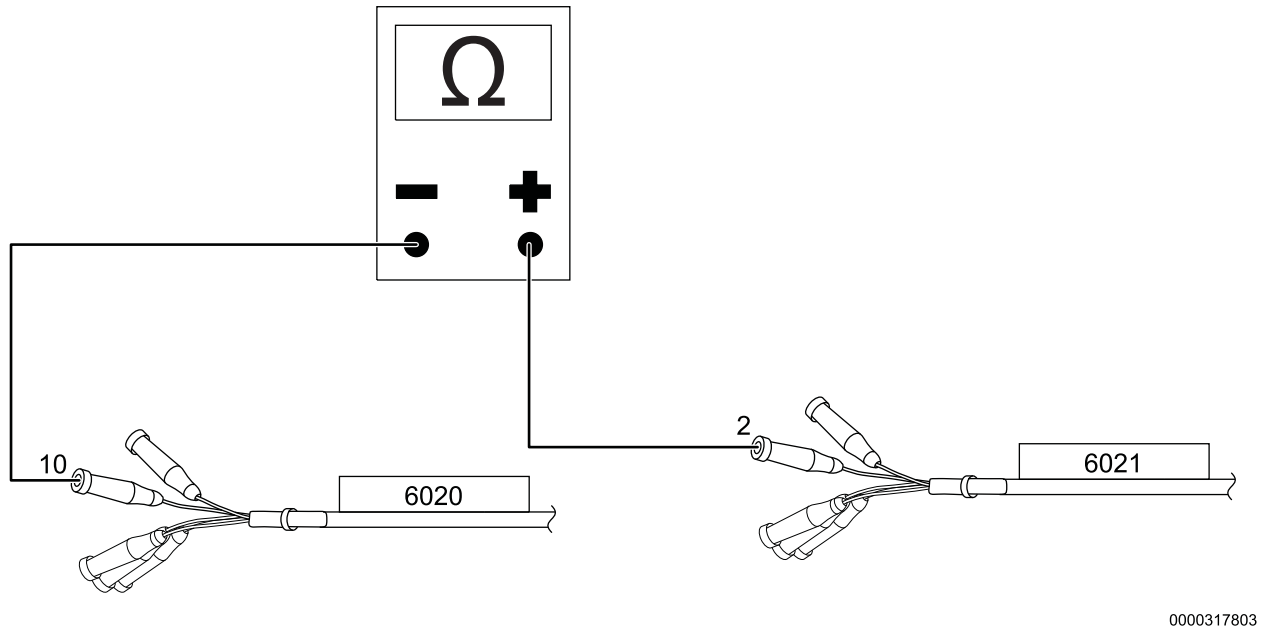


Figure 88 Test 7 AFT: FPC Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected. C. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and Breakout Harness ZTSE6020 pin-10.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 4.
	No: Repair Open between 24-pin engine to chassis connector pin-10 and AFT: FPC pin-2. After repairs are complete, retest for SPN 3479 FMI 4.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3479 FMI 4 fault code diagnostics.

SPN 3479 FMI 5 - AFT Fuel Pressure Valve Open or Short to GND low side

Condition / Description	Setting Criteria	Enable Condition / Values
Short to Ground Low Side	Circuit Current < 150 mA	Key ON Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects a short to ground on low-side circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Doser Control Unit (DCU) deactivates circuits when a circuit fault is present, so NOID lamp is needed to simulate correct circuit. Fault is latched for a key cycle, so Engine Control Module (ECM) must be reset by a Key OFF cycle.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DCU circuit fault
- Failed Aftertreatment Fuel Pressure Control (AFT: FPC)

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF and wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform Key-On Engine-Off (KOEO) DCU Actuator Test - Actuator Output High and Low Diagnostics(page 2156).		Yes: Go to Step 2.
Is EST DTC list SPN 3479 FMI 5 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
A. Key OFF.		Yes: Go to Step 3.
B. Disconnect AFT: FPC connector. C. Check AFT: FPC connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 5.
Are AFT: FPC connector, harness, and terminals clean and undamaged?		

Step 3	Check vehicle harness / NOID lamp illumination.	Decision
A. Key OFF. B. Connect NOID lamp to vehicle harness and leave AFT: FPC disconnected.		Yes: Replace AFT: FPC. After repairs are complete, retest for SPN 3479 FMI 5.
C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics(page 2156).		No: Perform Pin-Point Tests .
Did NOID light illuminate?		

Step 4	Inspect connections at 86-pin Doser Control Unit (DCU).	Decision
A. Key OFF.		Yes: Go to Pin-Point Tests(page 326).
B. Disconnect DCU. C. Check DCU and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing.		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 5.
Are 86-pin DCU module connector, harness, and terminals clean and undamaged?		

Pin-Point Tests (SPN 3479 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6020
- Breakout Harness ZTSE6021
- Digital Multimeter (DMM)
- Terminal Test Kit ZTSE4435C

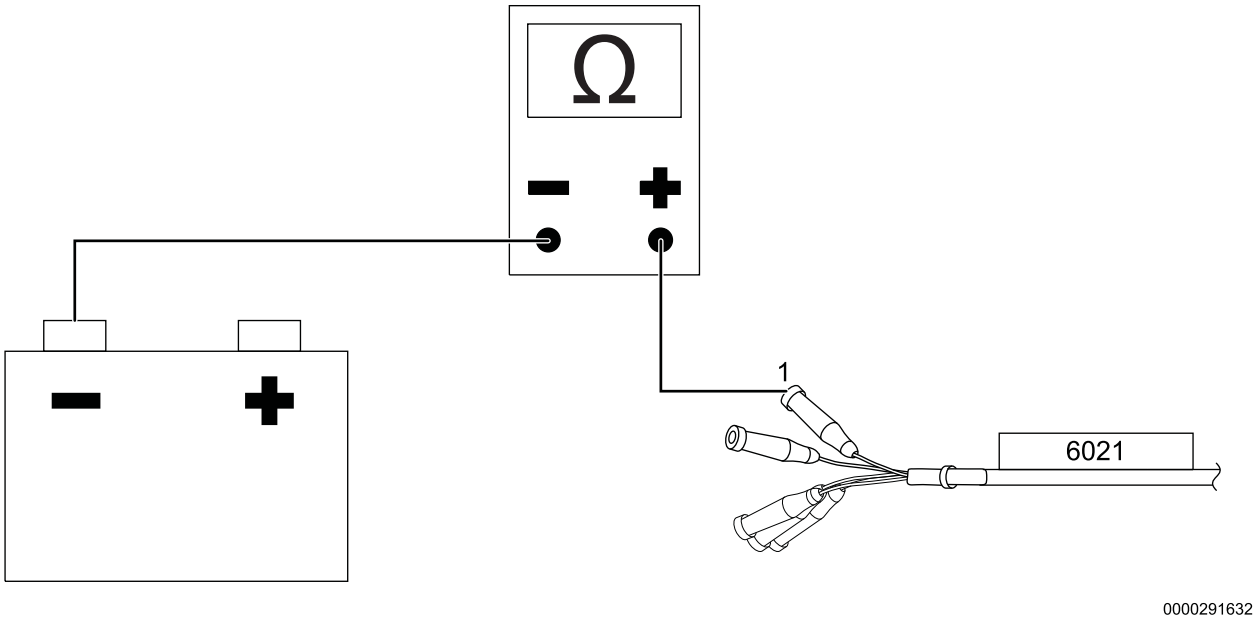


Figure 89 Test 1 AFT: FPC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Go to Test 2.

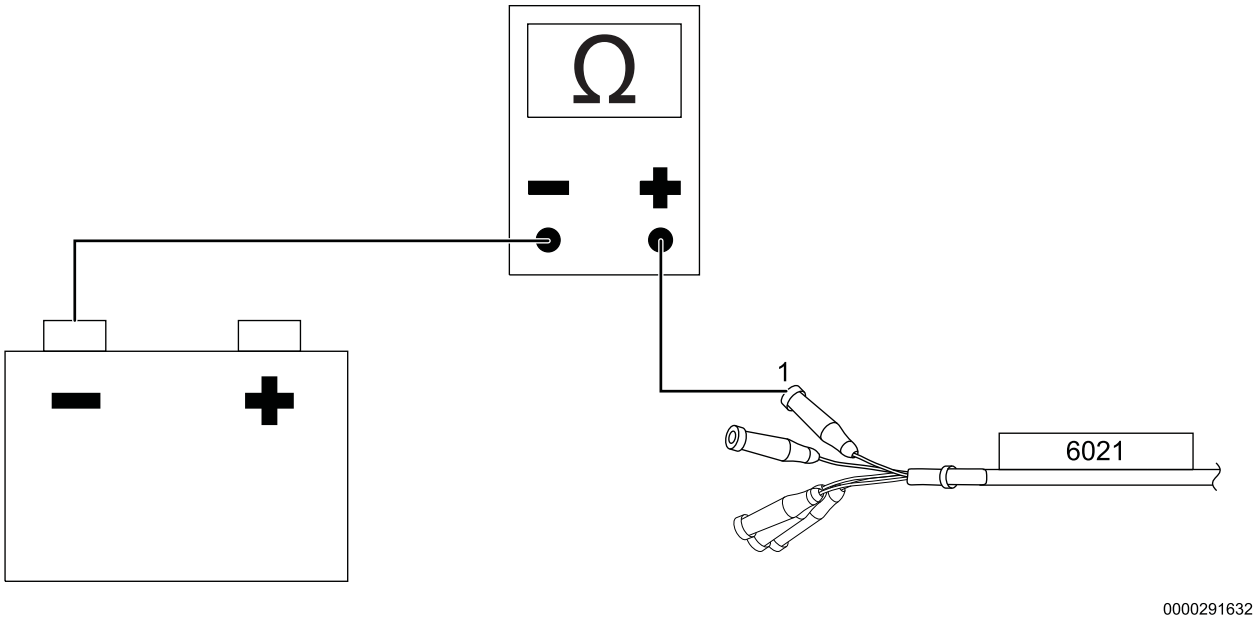


Figure 90 Test 2 AFT: FPC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Disconnect 24-Pin engine to chassis connector.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to GND between 24-Pin engine to chassis connector pin-9 and Doser Control Unit (DCU) pin-30. After repairs are complete, retest for SPN 3479 FMI 5.
	No: Repair short to GND between 24-Pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 5.

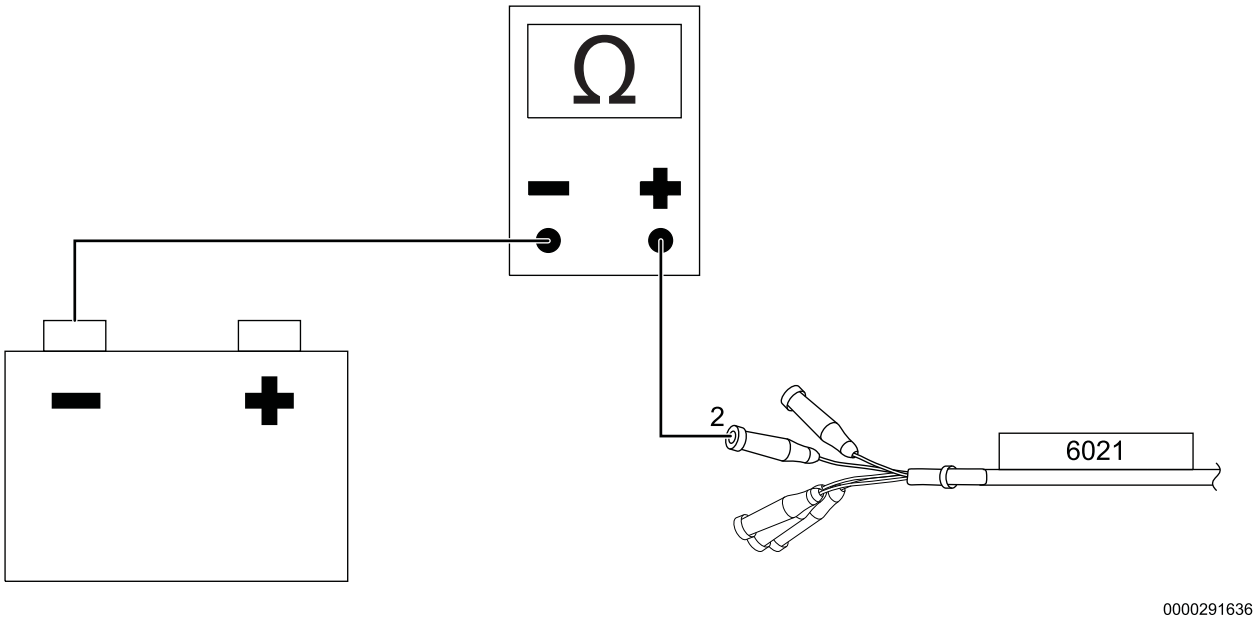


Figure 91 Test 3 AFT: FPC Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Go to Test 4.

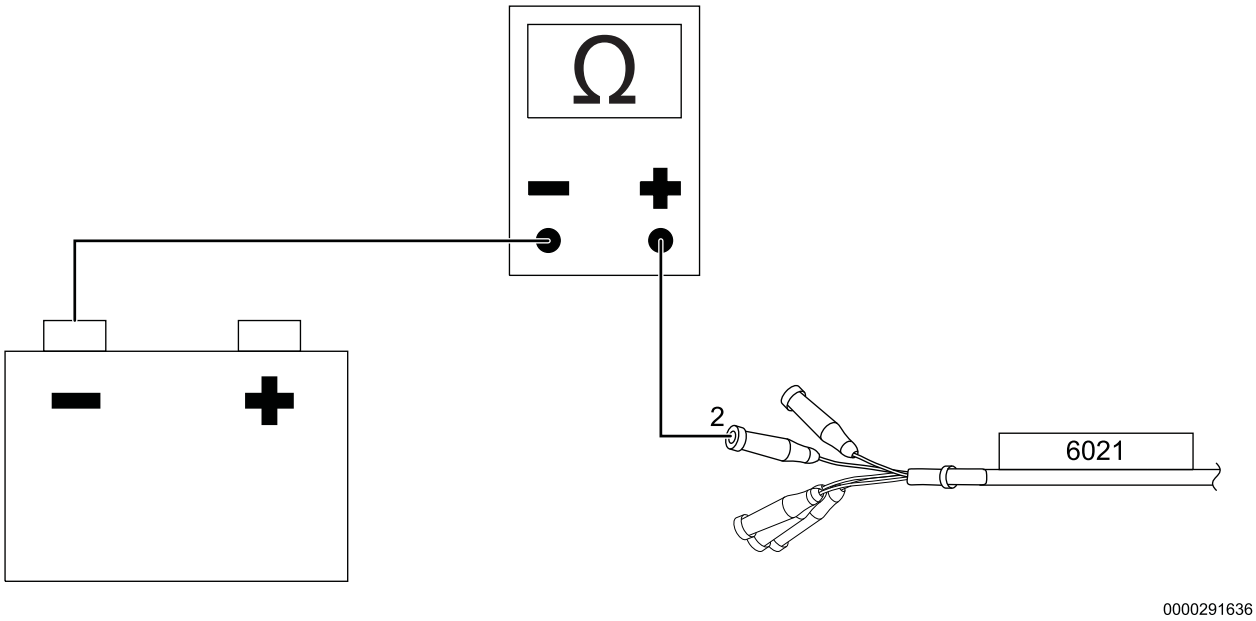


Figure 92 Test 4 AFT: FPC Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Disconnect 24-Pin engine to chassis connector.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 5.
	No: Repair short to ground between 24-pin engine to chassis connector pin-10 and Aftertreatment Fuel Pressure Control (AFT: FPC) pin-2. After repairs are complete, retest for SPN 3479 FMI 5.

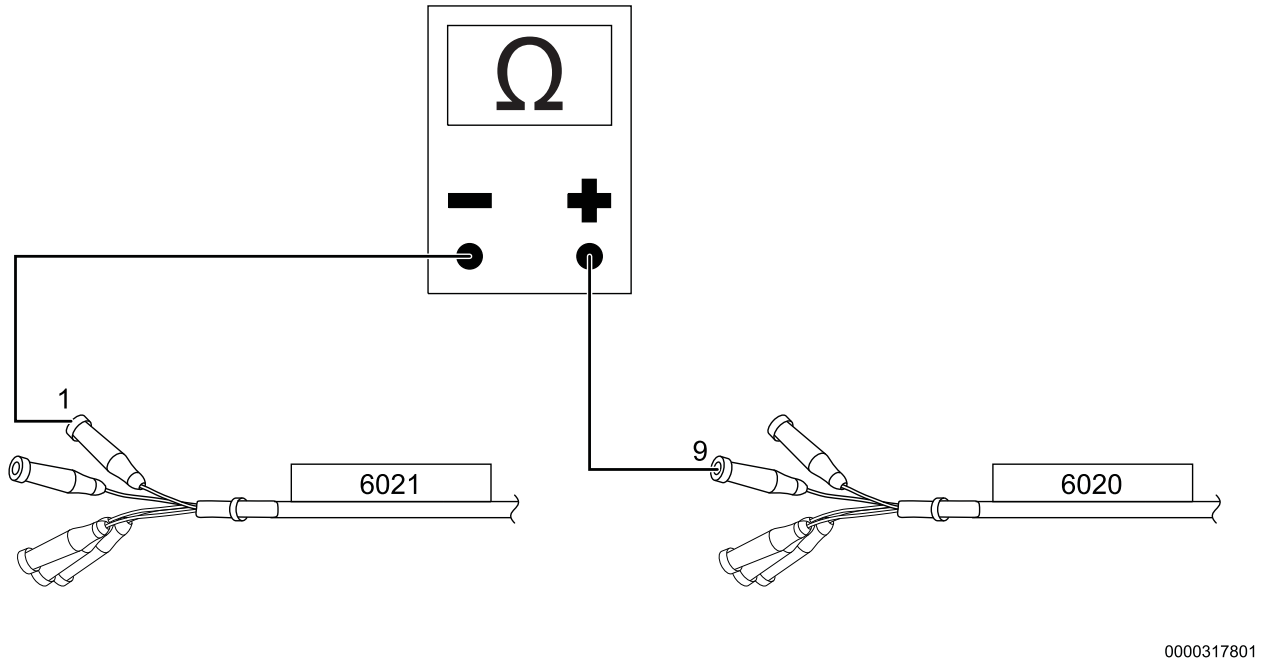


Figure 93 Test 5 AFT: FPC Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) and 24-pin engine and chassis connector. C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Connect Breakout Harness ZTSE6020 to engine side of 24-pin engine and chassis connector and leave chassis side disconnected.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and Breakout Harness ZTSE6020 pin-9.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Step 4 (page 319).
	No: Repair Open between 24-pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 5.

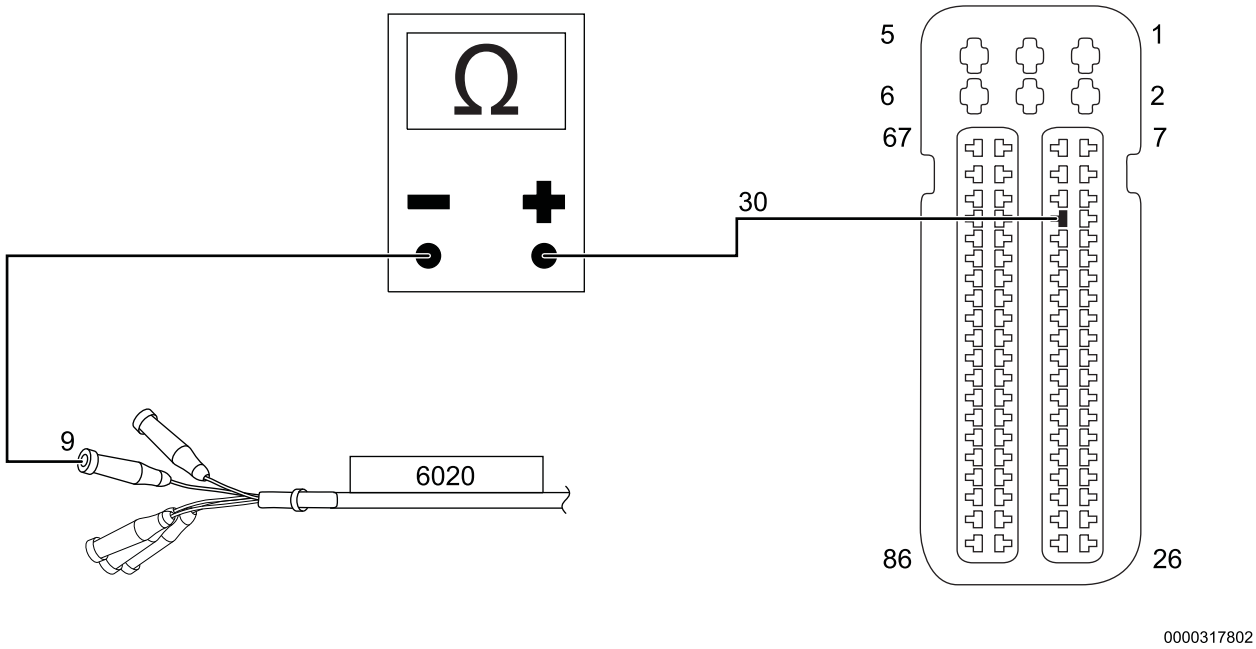


Figure 94 Test 6 AFT: FPC Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 24-pin engine and chassis connector. C. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected. D. Using Terminal Test Kit ZTSE4435C, insert correct terminal into Doser Control Unit (DCU) 86-pin connector pin-30.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-9 and DCU Module pin-30.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7.
	No: Repair Open between 24-pin engine to chassis connector pin-9 and DCU pin-30. After repairs are complete, retest for SPN 3479 FMI 5.

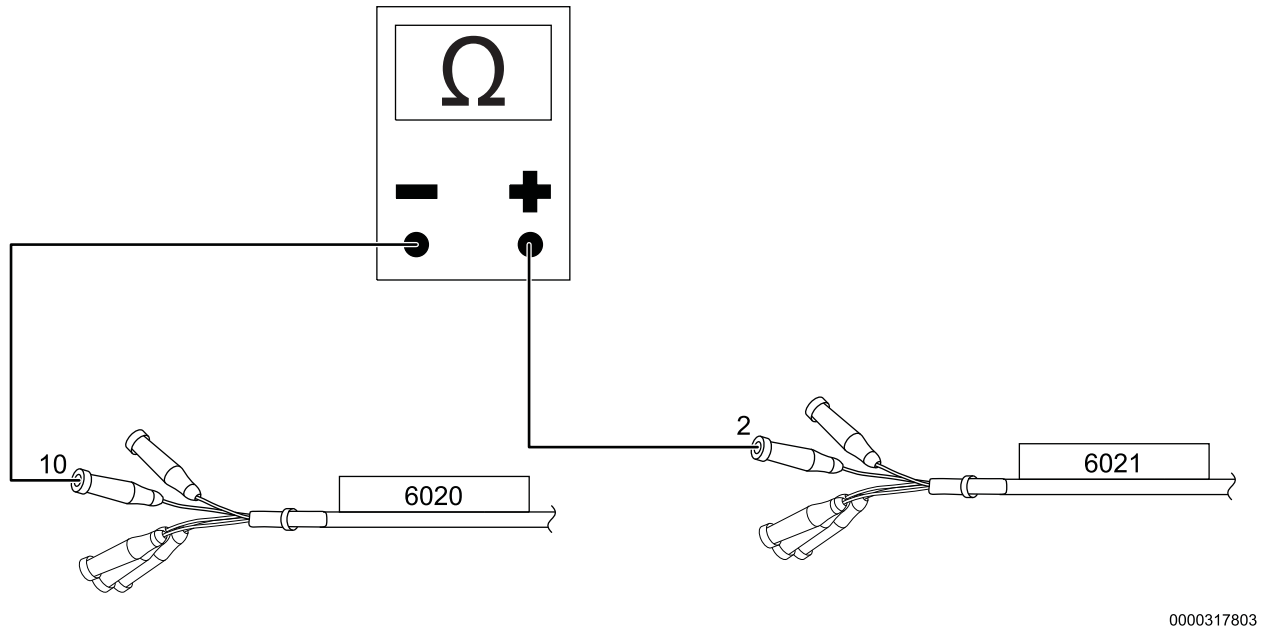


Figure 95 Test 7 AFT: FPC Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) and 24-pin engine and chassis connector. C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and Breakout Harness ZTSE6020 pin-10.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 5.
	No: Repair Open between 24-pin engine to chassis connector pin-10 and AFT: FPC pin-2. After repairs are complete, retest for SPN 3479 FMI 5.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3479 FMI 5 fault code diagnostics.

SPN 3479 FMI 6 - AFT Fuel Doser Valve High Side Short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
High-Side Short to Power or Open Load	Circuit Voltage < 0.3 Volts OR > 2 Volts	Key ON Battery voltage > 9 Volts AND < 16 Volts

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects a short to power or open load on high-side circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Doser Control Unit (DCU) deactivates circuits when a circuit fault is present, so NOID lamp is needed to simulate correct circuit. Fault is latched for a key cycle, so Engine Control Module (ECM) must be reset by a Key OFF cycle.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DCU circuit fault
- Failed Aftertreatment Fuel Pressure Control (AFT: FPC)

Step 1	Check for active or pending fault code.	Decision
A. Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear fault code. B. Key OFF and wait for ServiceMaxx™ software to disconnect. C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics(page 2156). Is EST Diagnostic Trouble Code (DTC) list SPN 3479 FMI 6 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
A. Key OFF. B. Disconnect AFT: FPC connector. C. Check AFT: FPC connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are AFT: FPC connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 6.

Step 3	Check vehicle harness / NOID lamp illumination.	Decision
A. Key OFF. B. Connect NOID lamp to vehicle harness and leave AFT: FPC disconnected. C. Key ON. D. Using EST with ServiceMaxx™ software, perform KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics(page 2156). Did NOID light illuminate?		Yes: Replace AFT: FPC. After repairs are complete, retest for SPN 3479 FMI 6. No: Perform Pin-Point Tests .

Step 4	Inspect connections at 86-pin Doser Control Unit (DCU).	Decision
A. Key OFF. B. Disconnect DCU. C. Check DCU and connector terminals for damaged or pinched wires, corroded terminals; loose, bent or broken pins; or broken connector housing. Are 86-pin DCU connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests(page 336). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3479 FMI 6.

Pin-Point Tests (SPN 3479 FMI 6)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6020
- Breakout Harness ZTSE6021
- Digital Multimeter (DMM)
- Terminal Test Kit ZTSE4435C

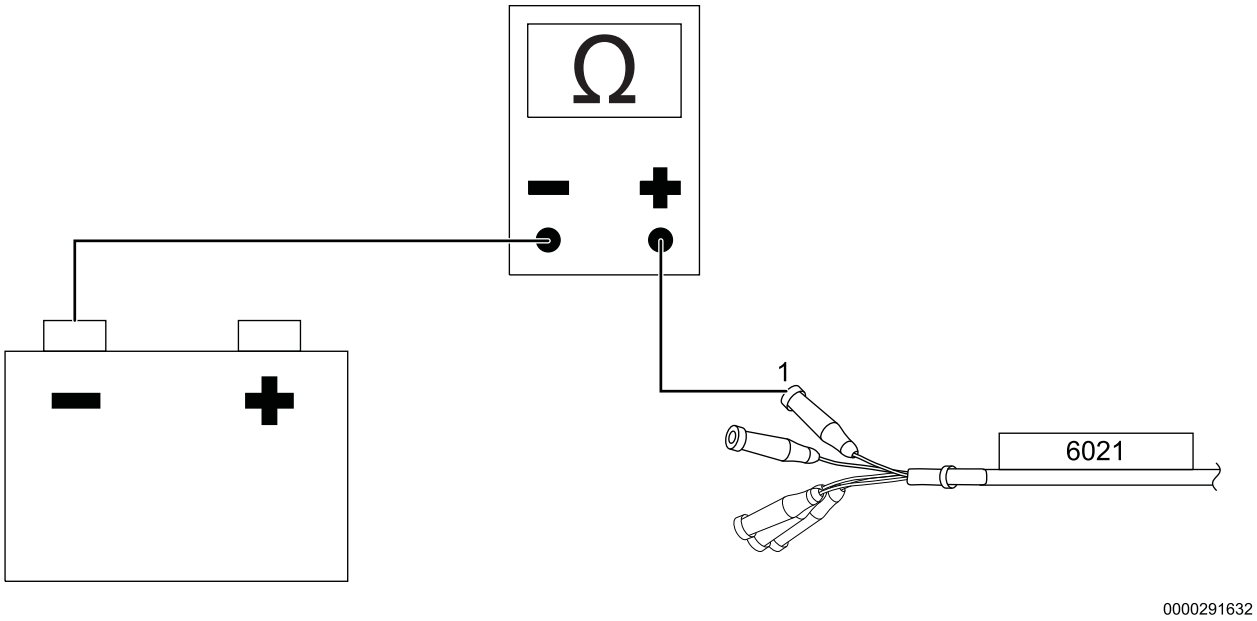


Figure 96 Test 1 AFT: FPC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Key ON

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Go to Test 2.

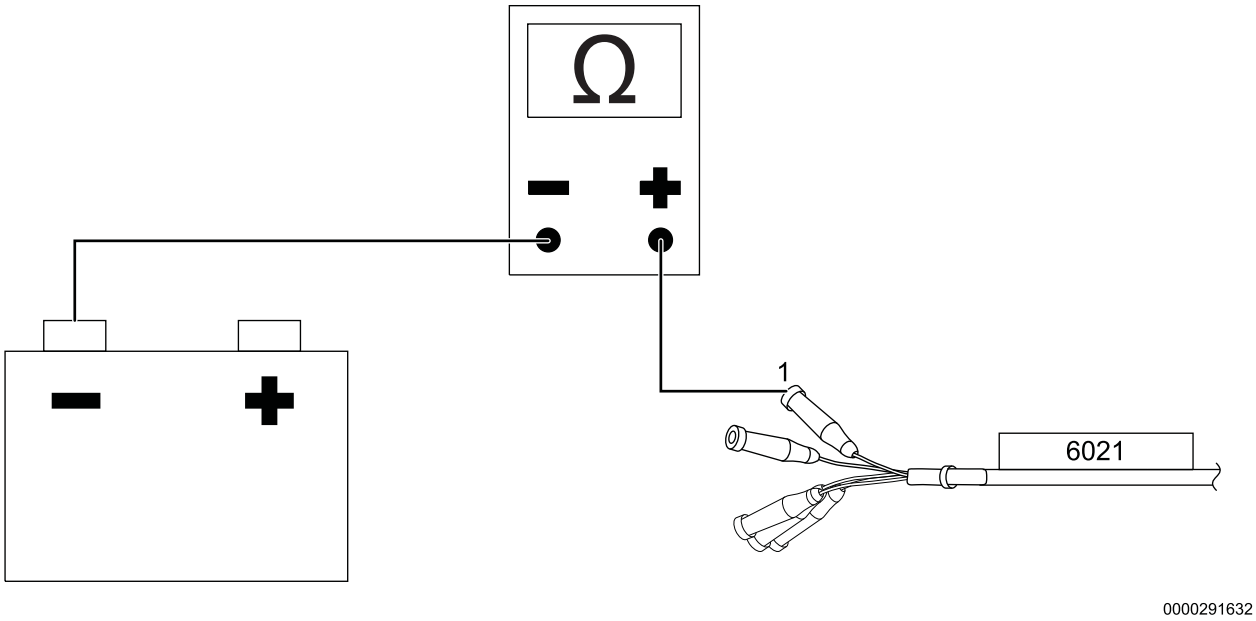


Figure 97 Test 2 AFT: FPC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Disconnect 24-pin engine to chassis connector. E. Key ON

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin engine to chassis connector pin-9 and Doser Control Unit (DCU) pin-30. After repairs are complete, retest for SPN 3479 FMI 6.
	No: Repair short to ground between 24-pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 6.

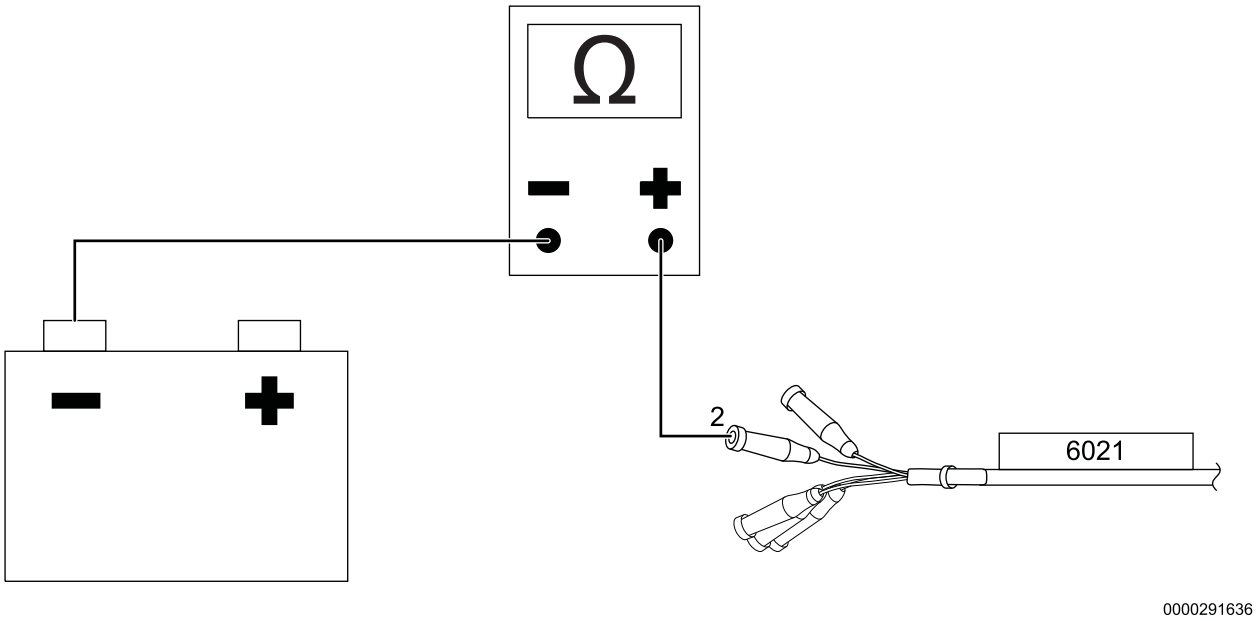


Figure 98 Test 3 AFT: FPC Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC). C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Key ON

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Go to Test 4.

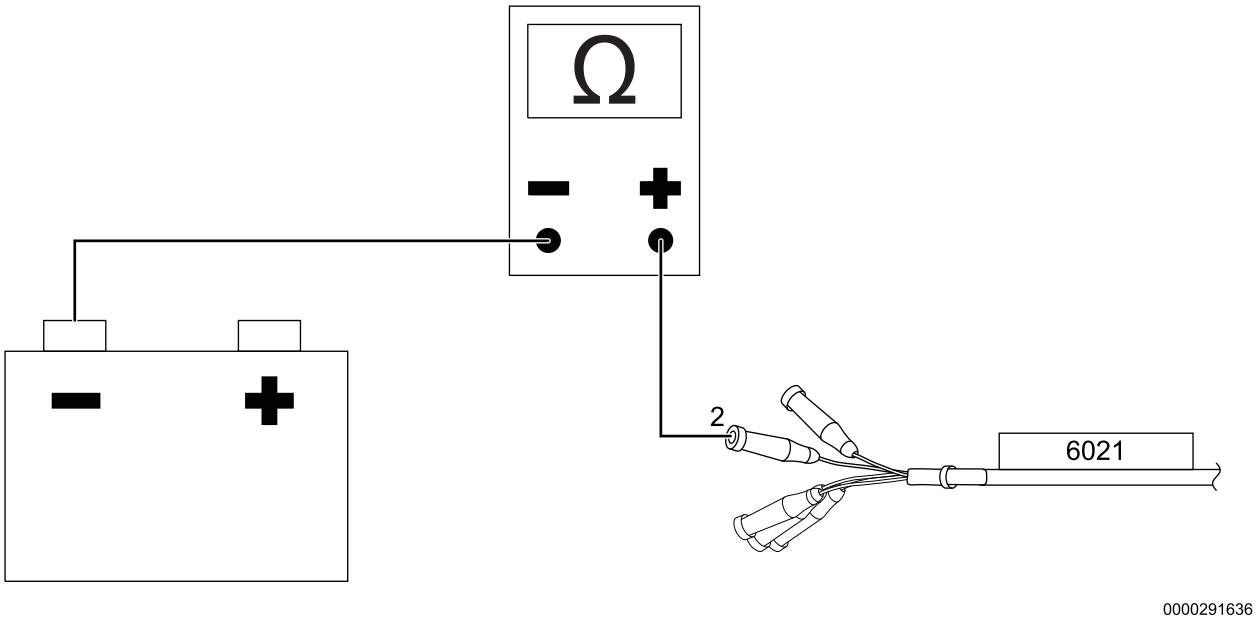


Figure 99 Test 4 AFT: FPC Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC). C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Disconnect 24-pin engine to chassis connector.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to ground between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 6.
	No: Repair short to ground between 24-pin engine to chassis connector pin-10 and Aftertreatment Fuel Pressure Control (AFT: FPC) pin-2. After repairs are complete, retest for SPN 3479 FMI 6.

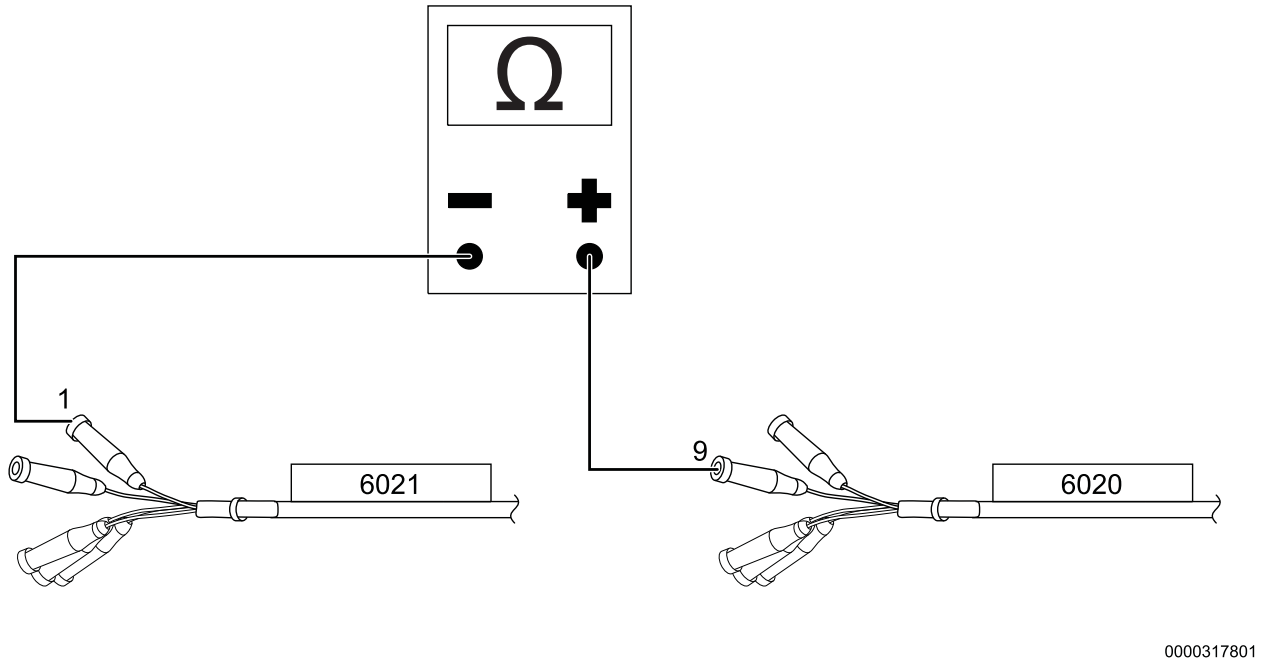


Figure 100 Test 5 AFT: FPC Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) and 24-pin engine and chassis connector. C. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave AFT: FPC disconnected. D. Connect Breakout Harness ZTSE6020 to engine side of 24-pin engine and chassis connector and leave chassis side disconnected.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-1 and Breakout Harness ZTSE6020 pin-9.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Diagnostic Step 4 (page 329).
	No: Repair Open between 24-pin engine to chassis connector pin-9 and AFT: FPC pin-1. After repairs are complete, retest for SPN 3479 FMI 6.

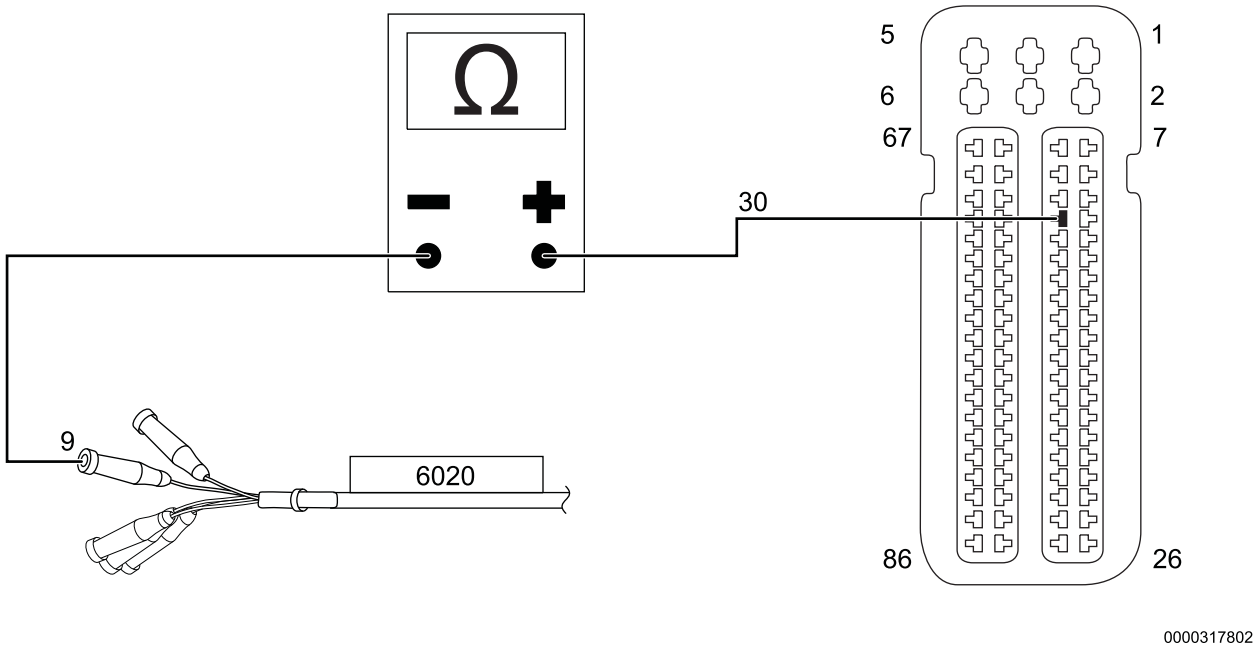


Figure 101 Test 6 AFT: FPC Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 24-pin engine and chassis connector and Doser Control Unit (DCU) 86-Pin connector. C. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected. D. Using Terminal Test Kit ZTSE4435C, insert correct terminal into Doser Control Unit (DCU) 86-Pin connector pin-30.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6020 pin-9 and DCU pin-30.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7.
	No: Repair Open between 24-pin engine to chassis connector pin-9 and DCU pin-30. After repairs are complete, retest for SPN 3479 FMI 6.

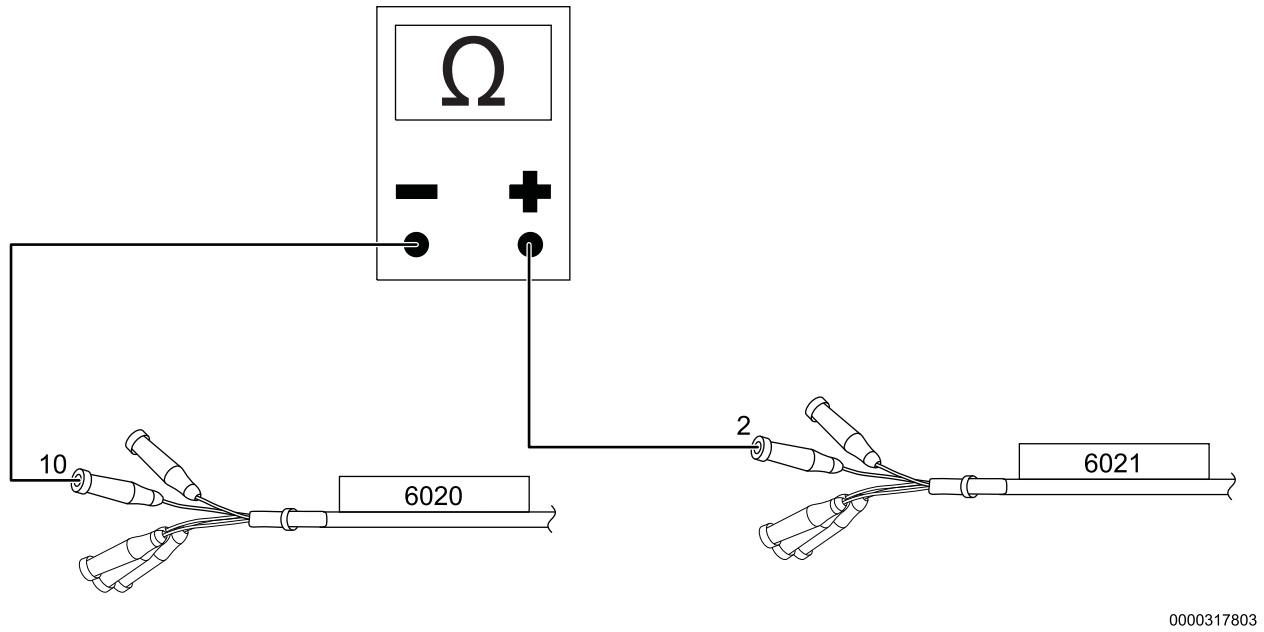


Figure 102 Test 7 AFT: FPC Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6021 to vehicle harness connector and leave Aftertreatment Fuel Pressure Control (AFT: FPC) disconnected. C. Connect Breakout Harness ZTSE6020 to chassis side of 24-pin engine and chassis connector and leave engine side disconnected.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6021 pin-2 and Breakout Harness ZTSE6020 pin-10.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open between 24-pin engine to chassis connector pin-10 and Doser Control Unit (DCU) pin-10. After repairs are complete, retest for SPN 3479 FMI 6.
	No: Repair Open between 24-pin engine to chassis connector pin-10 and AFT: FPC pin-2. After repairs are complete, retest for SPN 3479 FMI 6.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3479 FMI 6 fault code diagnostics.

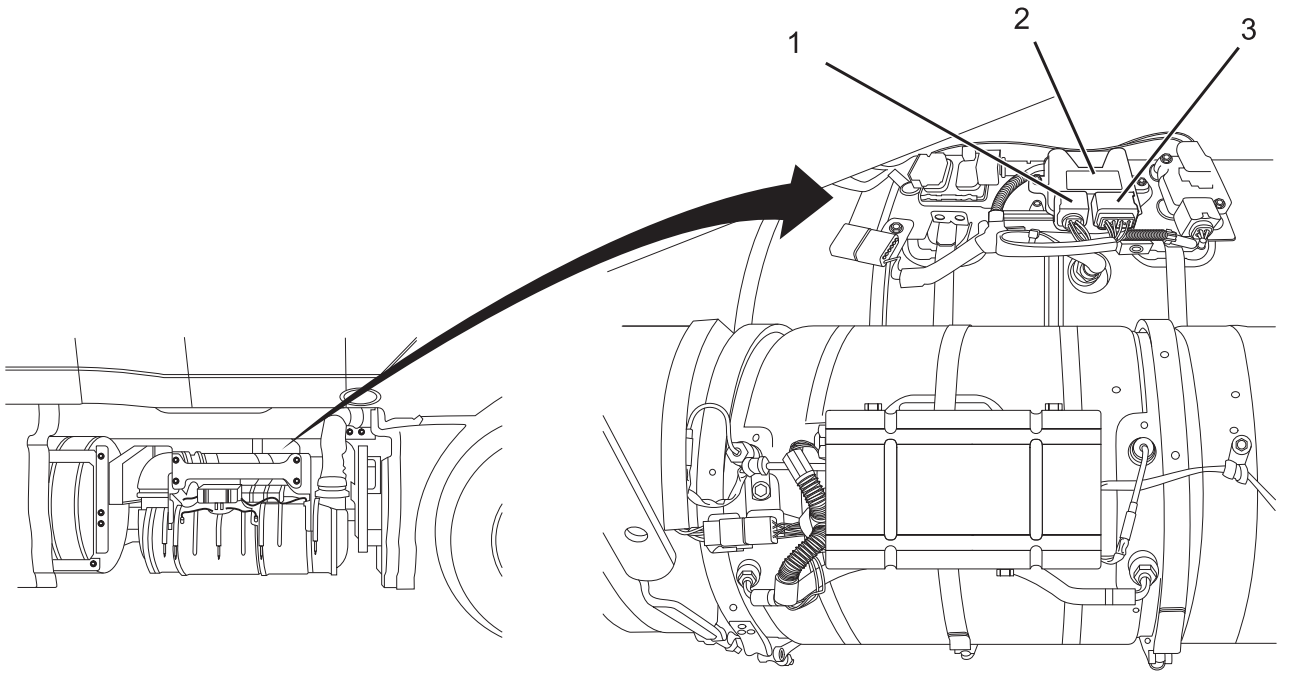
NH3 (Aftertreatment Ammonia) Sensor and Sensor Module

Overview of NH3 Sensor Group

SPN	FMI	Description
4377	2	NH3 in range stuck fault (page 341)
4377	3	NH3 Sensor signal Out of Range HIGH (page 344)
4377	4	NH3 operation fault (circuit fault) (page 346)
4377	12	NH3 internal chip error (page 349)
4377	13	NH3 operation fault (wrong sensor installed) (page 351)
4377	19	NH3 Sensor Module not detected on J1939 (page 353)
4380	2	NH3 signal erratic, intermittent, or incorrect (page 365)
4382	10	NH3 sensor Heater abnormal rate of change (page 373)
5302	18	Post SCR NH3 Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level (page 375)

Overview

Aftertreatment Ammonia (NH3) sensor module is a smart device used to measure NH3 levels in Selective Catalyst Reduction (SCR) Catalyst. NH3 sensor module performs internal diagnostics and reports malfunctions back to Aftertreatment Control Module (ACM) using J1939 CAN datalink. NH3 sensor is connected to NH3 sensor module via 8-pin connector.



0000055800

Figure 103 NH_3 Sensor Module Location (Typical)

1. NH_3 sensor module 4-pin connector
2. NH_3 sensor module
3. NH_3 sensor module 8-pin connector

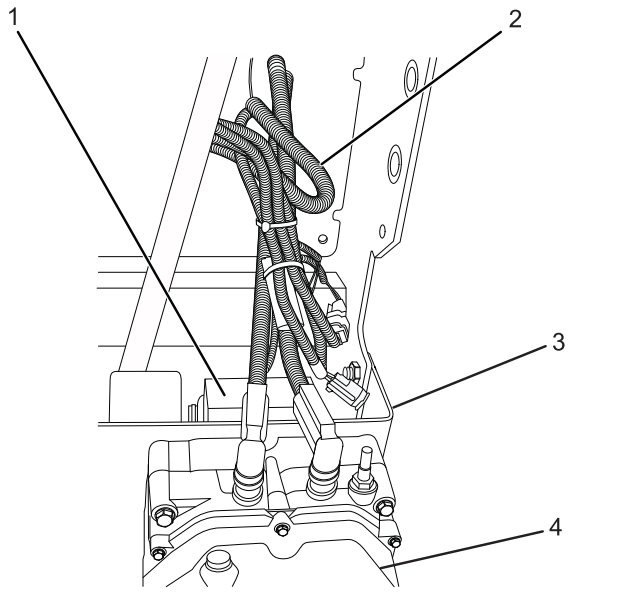


Figure 104 Power Distribution Module (PDM) Location (Typical)

1. PDM
2. Diesel Exhaust Fluid (DEF) lines
3. DEF tank bracket
4. DEF supply module

SPN 4377 FMI 2 - NH3 in range stuck fault

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Ammonia (NH3) sensor reading higher or lower than expected for operating conditions.	Measured minimum NH3 quantity drop rate > -1.3 ppm/sec	Engine Running Selective Catalyst Reduction (SCR) temperature between 482°F (250 °C) and 572°F (300°C) and rate of change ≥ 0.5°F/sec (0.3°C/sec) Aftertreatment Ammonia storage timer ≥ 150 seconds SCR temperature > 644°F (340°C) Time since peak SCR temperature > 20 seconds, and time since enabled > 10 seconds, and temperature difference between SCR peak temperature and SCR initial temperature > 27°F (15°C) NH3 sensor above 338°F (170°C) The following fault codes must be inactive: SPN 3246 FMI 2, 3, 4 (DPFOT); SPN 3361 FMI 2 (DEF supply pump); SPN 4360 FMI 2, 3, 4 (SCRIT); SPN 4363 FMI 2, 3, 4 (SCROT); SPN 4377 FMI 4, 12, 13 (NH3); SPN 4380 FMI 2, (NH3 Signal); SPN 4382 FMI 10 (NH3 Sensor); SPN 5742 FMI 3, 4, 9, 11 (DPF temp sensor module); SPN 5743 FMI 3, 4, 9, 11 (SCR temp sensor)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Aftertreatment Ammonia (NH3) sensor reading is higher or lower than expected for operating conditions.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4377 FMI 4 (NH3)	• SPN 4380 FMI 2 (NH3)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust system leaks
- Failed NH3 sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 341).		Yes: Go to Step 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4377 FMI 2.

Step 2	Inspect exhaust system for leaks and physical damage.	Decision
Inspect exhaust system for leaks and physical damage.		Yes: Go to Step 3.
Is exhaust system free of leaks and physical damage?		No: Repair or replace leaking or damaged exhaust components. After repairs are complete, retest for SPN 4377 FMI 2.

Step 3	Inspect connections at NH3 sensor module 8-way connector.	Decision
A. Key OFF. B. Disconnect NH3 sensor. C. Check NH3 sensor and sensor module connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Replace NH3 sensor. After repairs are complete, retest for SPN 4377 FMI 2.
Are NH3 sensor and sensor module connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4377 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4377 FMI 2 fault code diagnostics.

SPN 4377 FMI 3 - NH3 Sensor signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
NH3 Sensor signal Out of Range HIGH	Circuit fault in any of the Ammonia (NH3) sensor signal, ground, or heater wires.	NH3 sensor heater is ON NH3 at operating temperature NH3 sensor above 338°F (170°C)

Fault Overview

Fault code sets when an internal circuit error has been detected in the aftertreatment Ammonia (NH3) sensor. Engine torque will be reduced if the engine is operated for a limited period of time with the fault code active. Engine torque will be severely reduced and vehicle speed will be limited after extended operation with the fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL)will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 4380 FMI 2, 16, 18 (NH3)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NH3 sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 344). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4377 FMI 3.

Step 2	Ammonia (NH3) sensor and connector inspection	Decision
A. Key OFF. B. Disconnect NH3 sensor. C. Check NH3 sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NH3 sensor connector, harness, and terminals clean and undamaged?		Yes: Replace NH3 sensor. After repairs are complete, retest for SPN 4377 FMI 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4377 FMI 3.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4377 FMI 3 fault code diagnostics.

SPN 4377 FMI 4 - NH3 operation fault (circuit fault)

Condition / Description	Setting Criteria	Enable Conditions / Values
Circuit fault in any of the Aftertreatment Ammonia (NH3) sensor signal, ground, or heater wires.	Absolute value of NH3 signal during pulse ON time minus NH3 signal during pulse OFF time < 20 mV and absolute value of NH3 signal at pulse OFF ≥ 250.8 mV Voltage between heater positive pin of NH3 sensor and ground > 4.41 volts Impedance of temperature cell in NH3 sensor < 200 ohms Voltage across temperature cell of NH3 sensor > 4.99 volts, or NH3 sensor has met operating temperature once since power up, impedance of temperature cell in NH3 sensor > 3,000 ohms NH3 sensor internal temperature cell impedance difference between pulse ON and OFF < 50 ohms Voltage between the NH3 sensor signal ground pin and ground > 250 mV Voltage at common terminal of changeover switch > 1.8 volts AND < 3.8 volts Voltage between heater positive pin of NH3 sensor and ground < 0.71 volts Absolute value of NH3 signal during pulse ON time minus NH3 signal during pulse OFF time < 20 mV and NH3 signal < 20 mV, or absolute value of NH3 signal during pulse ON time minus NH3 signal during pulse OFF time < 20 mV and absolute value of NH3 signal at pulse OFF < 250.8 mV and ≥ 20 mV	NH3 sensor heater is ON NH3 at operating temperature NH3 sensor above 338°F (170°C)

Fault Overview

Fault code sets when an internal circuit error has been detected in Aftertreatment Ammonia (NH3) sensor for 20 seconds. Engine torque will be reduced if engine is operated for a limited period of time with fault code active. Engine torque will be severely reduced and vehicle speed will be limited after extended operation with fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 4380 FMI 2 (NH3)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NH3 sensor

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 347). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 4.

Step 2	Inspect connections at NH3 sensor module.	Decision
A. Key OFF. B. Disconnect NH3 sensor connector. C. Check NH3 sensor and sensor module connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NH3 sensor and sensor module connector, harness, and terminals clean and undamaged?		Yes: Replace NH3 sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 4. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 4.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4377 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4377 FMI 12 - NH3 internal chip error

Condition / Description	Setting Criteria	Enable Conditions / Values
NH3 sensor module has detected an internal error.	The NH3 sensor module has an internal RAM failure, code checksum mismatch, or an internal Application Specific Integrated Circuit (ASIC) and SPI bus communication failure.	Key ON

Fault Overview

Fault Code is set when Aftertreatment Ammonia (NH3) sensor module has detected an internal error.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NH3 sensor module

Step 1	Replace NH3 sensor module.
Replace NH3 sensor module. Repair or replace NH3 sensor module heat shield if missing or damaged.	

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4377 FMI 12 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4377 FMI 13 - NH3 operation fault (wrong sensor installed)

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Ammonia (NH3) sensor module has detected the trim resistor is out of range (wrong sensor installed).	The functional resistance of the sensor internal trim resistor is greater than 2,000 ohms or less than 500 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Ammonia (NH3) sensor module has detected the trim resistor in the NH3 sensor is out of range, indicating the wrong NH3 sensor may be installed.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Incorrect or failed NH3 sensor

Step 1	Inspect connections at NH3 sensor module.	**Decision**
A. Key OFF. B. Disconnect NH3 sensor. C. Check NH3 sensor and sensor module connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Install correct NH3 sensor. After repairs are complete, retest for SPN 4377 FMI 13.
Are NH3 sensor and sensor module connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4377 FMI 13.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4377 FMI 13 fault code diagnostics.

SPN 4377 FMI 19 - NH3 Sensor Module not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Ammonia (NH3) sensor module not detected on J1939 Controller Area Network (CAN).	Aftertreatment Control Module (ACM) loses J1939 data link communications with NH3 sensor module	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) loses J1939 data link communications with Aftertreatment Ammonia (NH3) sensor module. If resistance is greater than 60 ohms and there is more than one J1939 data link communication bus failure fault code present, suspect a failed terminating resistor.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

If more than one of the following sensor modules fail (or set a fault), suspect a common power circuit, ground circuit, or switched ignition relay problem. The following components share power and ground circuits: DOC / DPF temperature sensor module, SCR temperature sensor module, NH3 sensor module, NOx OUT sensor module, NOx IN sensor module, and DEF: TLT sensor module.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SWBAT circuit Open, high resistance, or short to GND
- CAN-AH circuit Open or short to GND
- CAN-AL circuit Open or short to GND
- CAN-AH circuit short to PWR
- CAN-AL circuit short to PWR
- GND circuit Open or high resistance
- CAN-AH short to CAN-AL
- Failed NH3 sensor module

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3216 FMI 19, SPN 3226 FMI 19, SPN 5742 FMI 19, and SPN 5743 FMI 19.		Yes: Go to Step 2.
Is EST DTC list SPN 3216 FMI 19, SPN 3226 FMI 19, SPN 5742 FMI 19, and SPN 5743 FMI 19. show as active or pending?		No: Go to Step 3.

Step 2	Inspect connections at NH3 sensor module 4-way connector.	Decision
A. Key OFF. B. Disconnect NH3 sensor module 4-way connector. C. Check NH3 sensor module and 4-way connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are NH3 sensor module 4-way connector, harness, and terminals clean and undamaged?		Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4377 FMI 19.

Step 3	Inspect connections at NH3 sensor module 12-pin connector.	Decision
A. Key OFF. B. Disconnect NH3 sensor module 4-pin connector. C. Check NH3 sensor module and 4-pin connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Perform Pin-Point Test.
Are NH3 sensor module 4-pin connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4377 FMI 19.

Pin-Point Tests (SPN 4377 FMI 19)

(NH_3) Sensor/Module Circuit

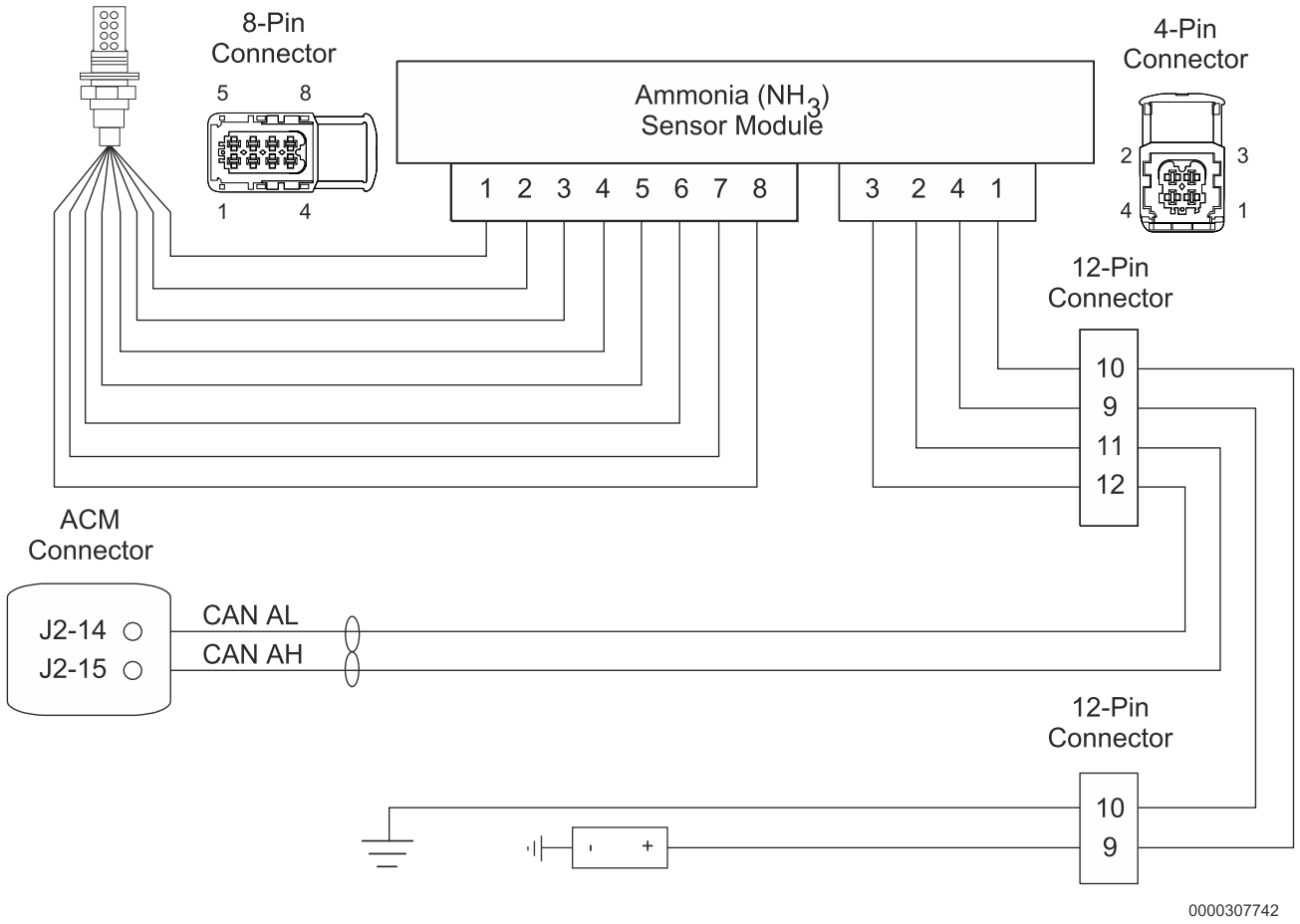
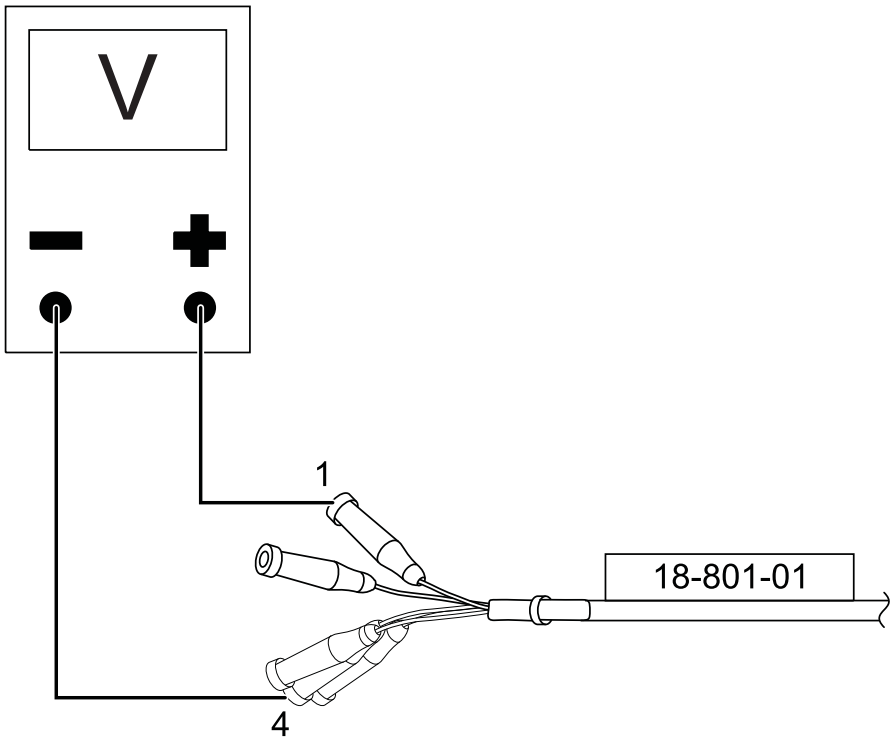


Figure 105 NH3 Sensor Module Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-801-01
- Digital Multimeter (DMM)



0000308561

Figure 106 Test 1 NH3 Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and SCR harness connector. C. Key ON.

Test 1		Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-1 and pin-4.		Yes: Go to Test 4.
Is voltage B+ ± 0.5 volts?		No: Go to Test 2.

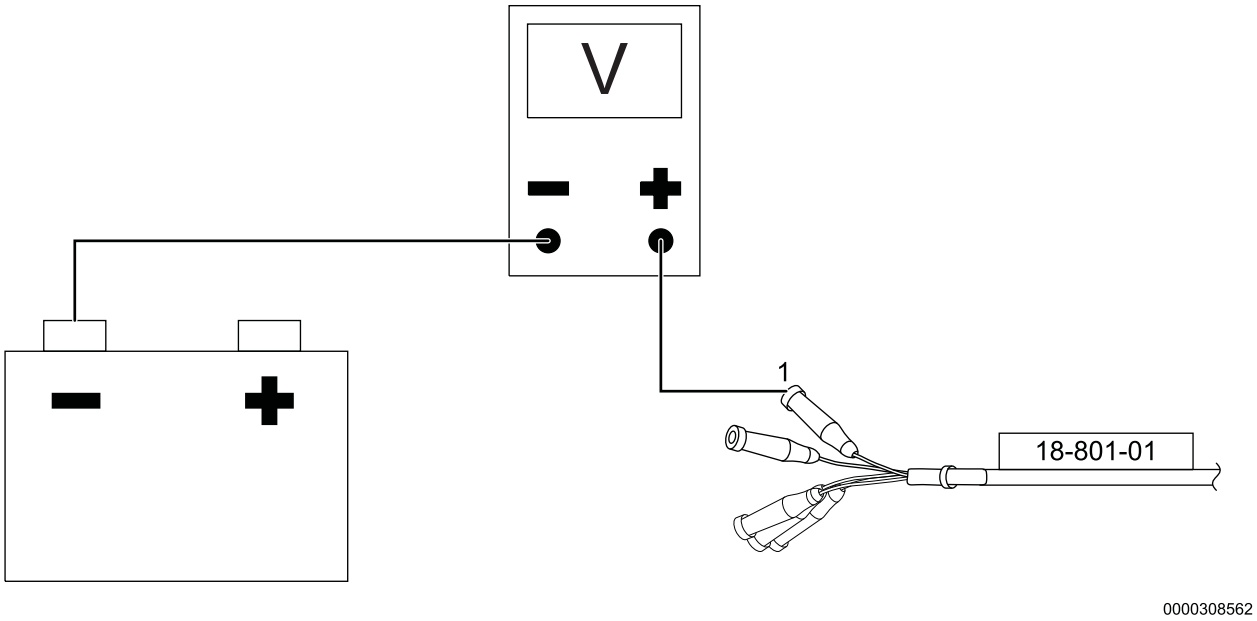


Figure 107 Pin-Point Test 2 NH3 Sensor Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way SCR harness connector. C. Key ON.

Test 2	Check for Open or high resistance between NH3 sensor module and ground.	Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-1 and known good ground.		Yes: Repair Open or high resistance between NH3 sensor module pin-4 and ground. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.
Is voltage B+ ± 0.5 volts?		No: Go to Test 3.

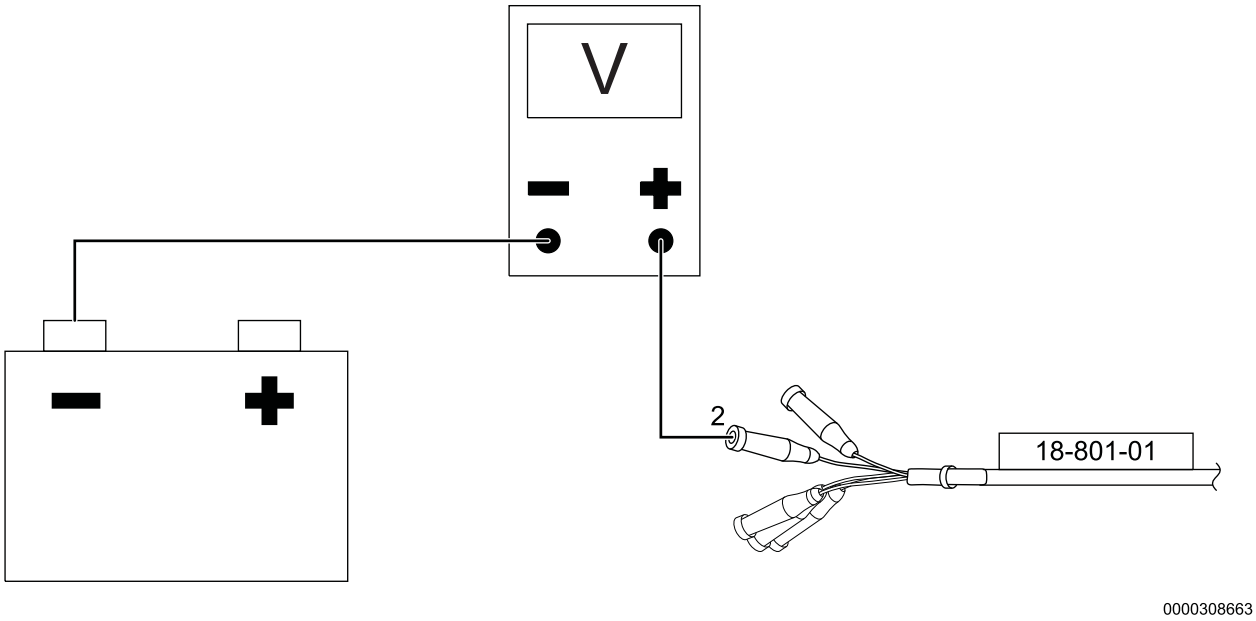


Figure 108 Test 3 NH3 Sensor Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way SCR harness connector. C. Key ON.

Test 3	Check for Open in Aftertreatment Harness.	Decision
Use DMM to measure voltage between 4–way connector, pin-2 and known good ground. Is voltage B+ ± 0.5 volts?		Yes: Repair Open in Aftertreatment Harness between 4-way connector pin-2 and pin-8, pin-12 and pin-14 connectors. No: Repair Open between 4-pin connector, pin-2 and switched ignition relay pin-87.

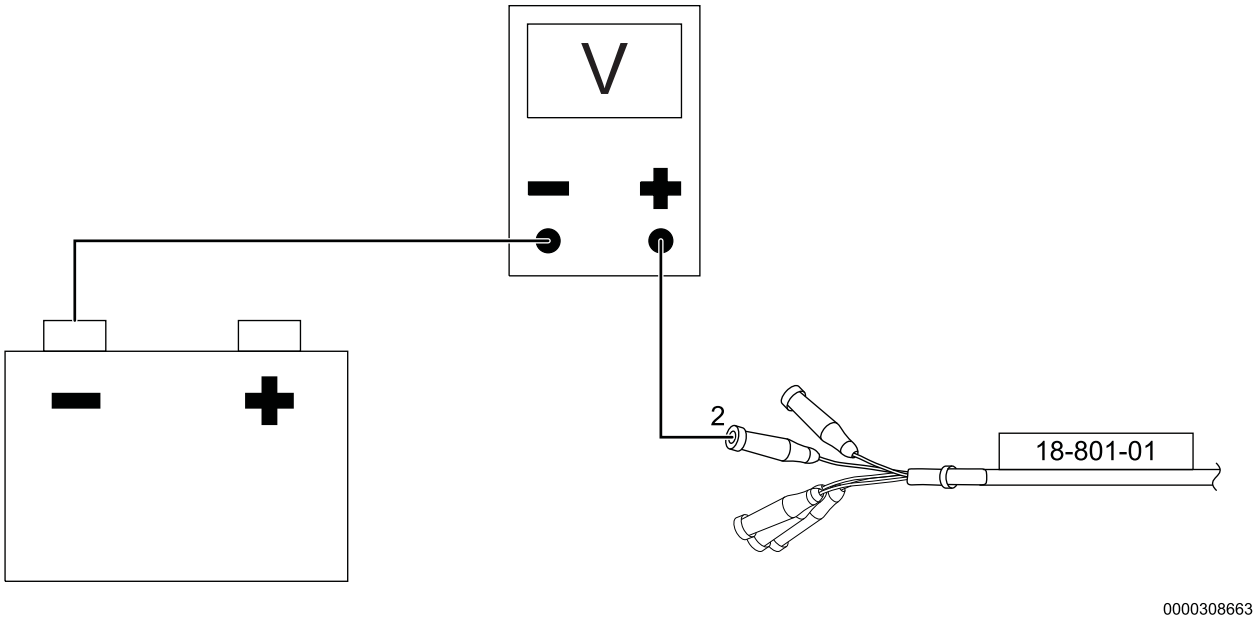


Figure 109 Test 4 NH3 Sensor Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way SCR harness connector. C. Key ON.

Test 4	Check for Open or short to ground between NH3 sensor module and ACM.	Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-2 and known good ground. Is voltage greater than 1 volt?		Yes: Go to Test 5. No: Repair Open or short to ground between NH3 sensor module connector pin-2 and ACM connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.

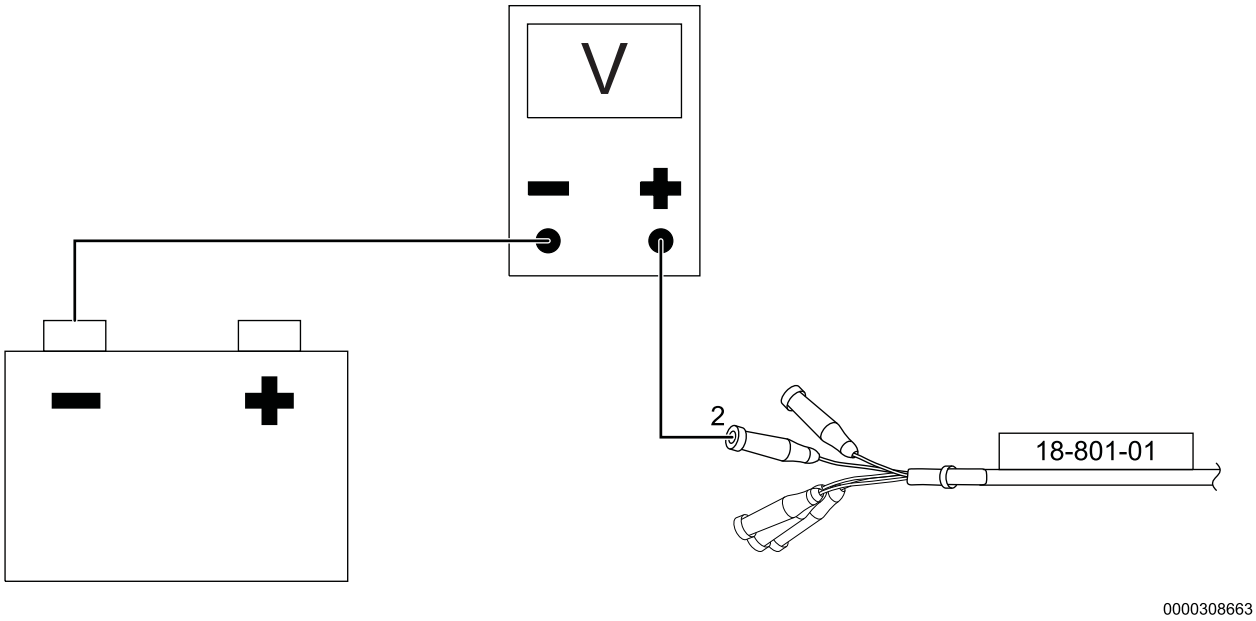


Figure 110 Test 5 NH3 Sensor Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way SCR harness connector. C. Key ON.

Test 5	Check for short to PWR between NH3 sensor module and ACM.	Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-2 and known good ground. Is voltage less than 4 volts?		Yes: Go to Test 6. No: Repair short to PWR between NH3 sensor module connector pin-2 and ACM connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.

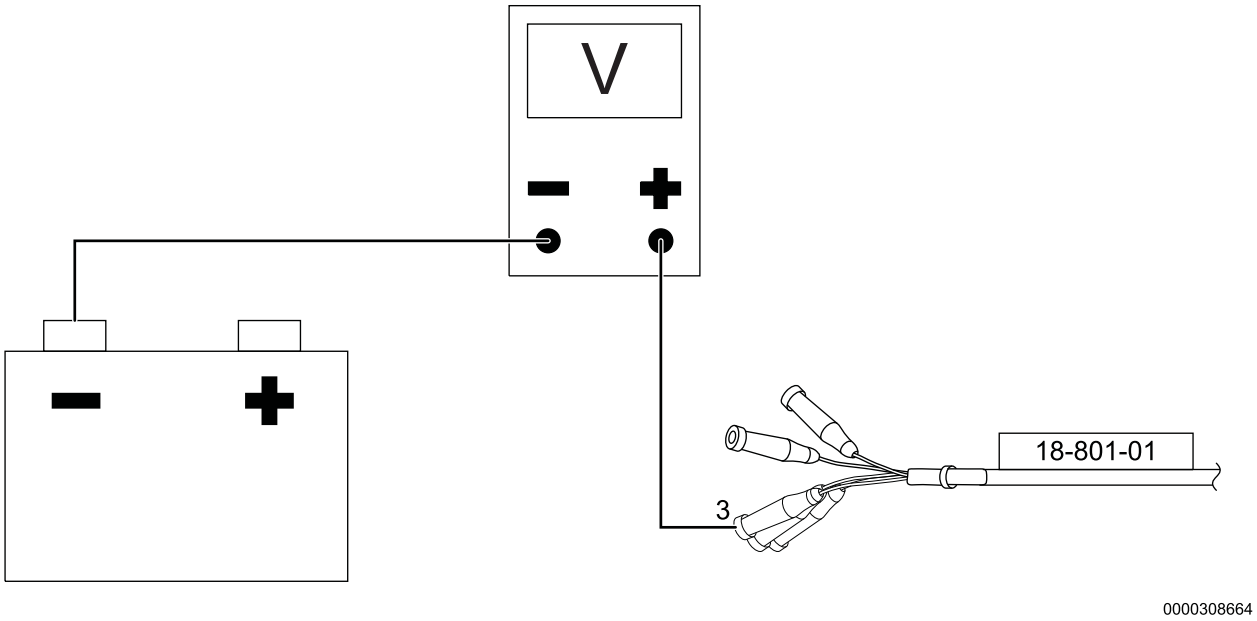


Figure 111 Test 6 NH3 Sensor Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way vehicle harness connector. C. Key ON.

Test 6	Check for Open or short to GND between NH3 sensor module and ACM.	Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-3 and known good ground. Is voltage greater than 1 volt?		Yes: Go to Test 7. No: Repair open or short to GND between NH3 sensor module connector pin-3 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.

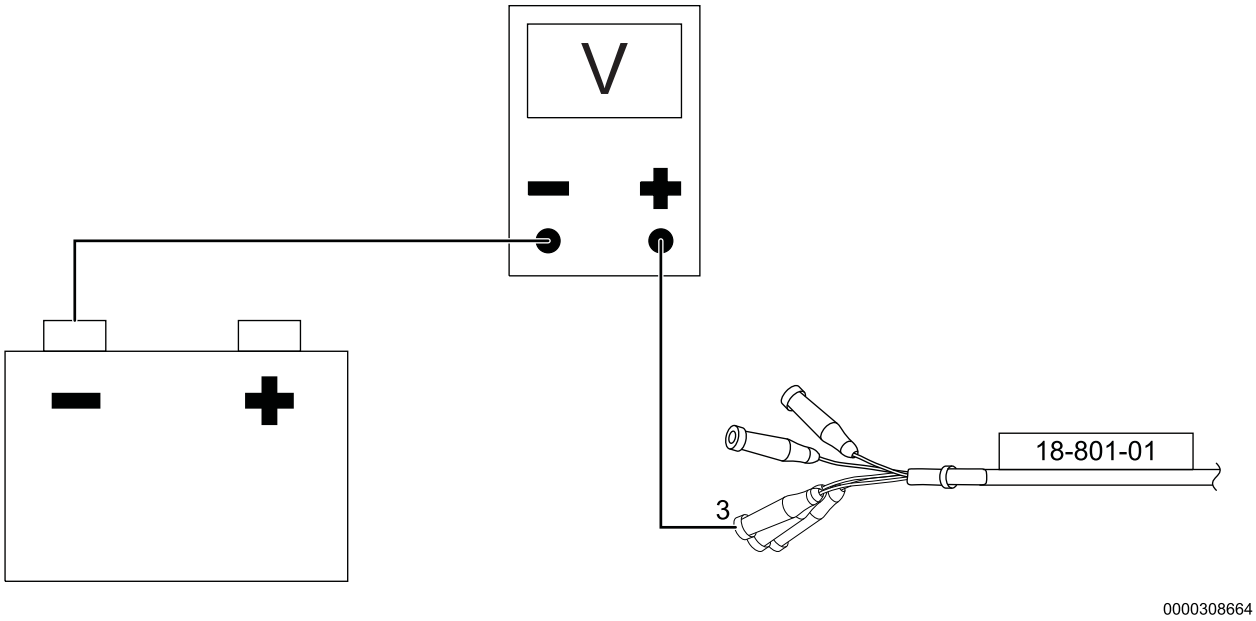
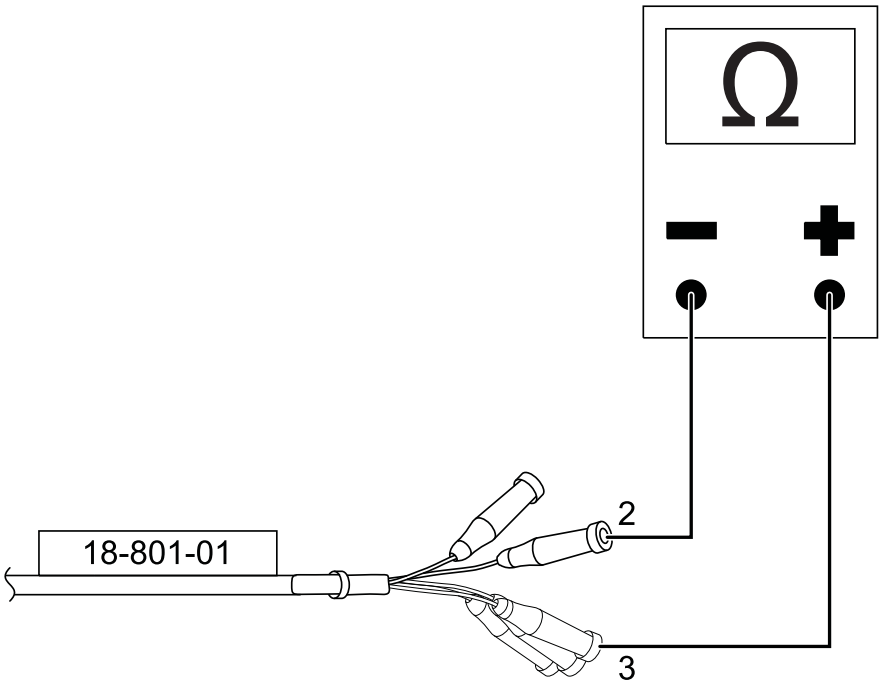


Figure 112 Test 7 NH3 Sensor Circuit Voltage Check

Test 7 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way vehicle harness connector. C. Key ON.

Test 7	Check for short to PWR between NH3 sensor module and ACM.	Decision
Use DMM to measure voltage between Breakout Harness 18-801-01 pin-3 and known good ground. Is voltage less than 4 volts?		Yes: Go to Test 8. No: Repair short to PWR between NH3 sensor module connector pin-3 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.



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Figure 113 Test 8 NH3 Sensor Circuit Resistance Check

Test 8 Setup
A. Key OFF. B. Connect Breakout Harness 18-801-01 between NH3 sensor module and 4-way vehicle harness connector. C. Key ON.

Test 8	Check for short between CAN-AL and CAN-AH circuits.	Decision
Use DMM to measure resistance between Breakout Harness 18-801-01 pin-2 and pin-3. Is resistance within 5 ohms of 60 ohms?		Yes: Replace NH3 sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19. No: Repair short between CAN-AL and CAN-AH circuits. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4377 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4377 FMI 19 fault code diagnostics.

SPN 4380 FMI 2 - NH3 signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Ammonia (NH_3) sensor power supply - erratic, intermittent, or incorrect resulting in an internal reset of the NH_3 sensor module.	Number of NH_3 sensor reset events ≥ 5 count within a 300 second window	Key-On Engine-Running (KOER) ≥ 10 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) has detected 10 or more internal resets of Ammonia (NH_3) sensor module. Engine torque will be reduced if engine is operated for a limited period of time with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

NH3 sensor module shares common power and ground with Nitrogen Oxide Outlet Concentration (NOx Out), Selective Catalyst Reduction (SCR) temp sensor module, and other aftertreatment components. If more than one aftertreatment power or ground fault is set, suspect a common power or ground circuit problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- GND circuit intermittent Open or high resistance
- Low battery voltage
- Loose fuse or relay in Power Distribution Module (PDM)
- Switch battery (SWBAT) circuit intermittent short to ground or Open
- Failed NH_3 sensor module

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4380 FMI 2. Is EST DTC list SPN 4380 FMI 2 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

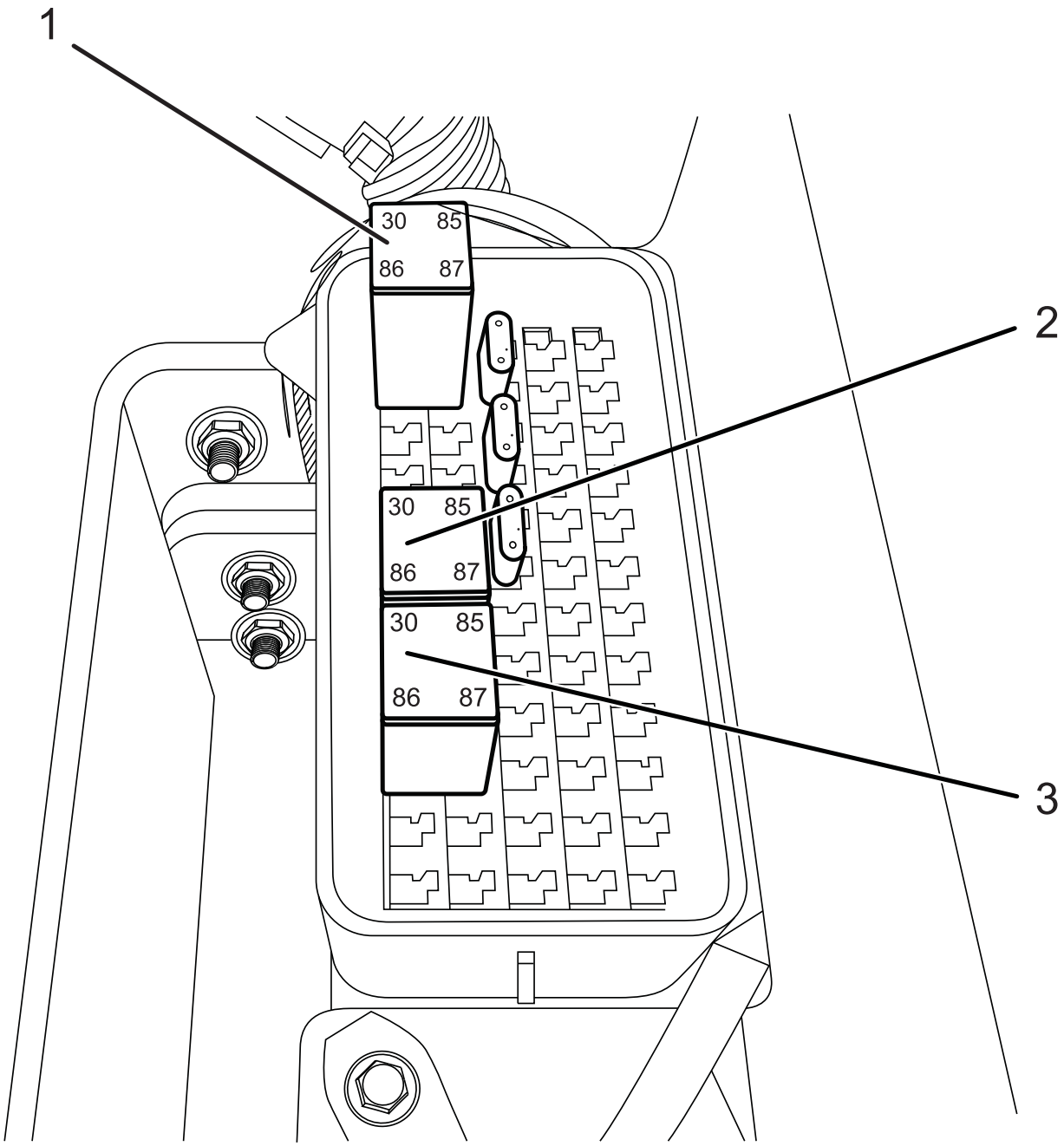


Figure 114 Power Distribution Module (PDM) Fuses and Relays

1. Diesel Exhaust Fluid Line Heater Relay
2. Diesel Exhaust Fluid Supply Module Heater (DEFSMH) Relay
3. Switched ignition relay

Step 2	Inspect PDM fuse(s) and relay(s).	Decision
A. Key OFF. B. Remove PDM cover. C. Check fuse(s) and relay(s) for blown fuses and loose, missing, or intermittent connections.		Go to Step 3.
Are all fuses and relays securely attached and in good condition?		No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 4380 FMI 2.

Step 3	Inspect connections at NH_3 sensor module 4-way connector.	Decision
A. Key OFF. B. Disconnect NH_3 sensor module 4-pin connector. C. Check NH_3 sensor module and 4-pin connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 4.
Are NH_3 sensor module 4-pin connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4380 FMI 2.

Step 4	Check for active or pending fault codes.	Decision
Perform Test 1(page 371). Use DMM to measure voltage between Breakout Harness 18-801-01 pin-1 and pin-4.		Yes: Replace NH_3 sensor module. After repairs are complete, retest for SPN 4380 FMI 2.
Is voltage B+ ± 0.5 volts?		No: Go to Step 5.

Step 5	Check for active or pending fault codes.	Decision
Perform Test 2(page 372). Use DMM to measure voltage between Breakout Harness 18-801-01 pin-1 and known good ground.		Yes: Repair Open or high resistance between NH_3 sensor module pin-4 and ground. After repairs are complete, retest for SPN 4380 FMI 2.
Is voltage B+ ± 0.5 volts?		No: Repair Open or short to ground between NH_3 sensor module connector pin-1 and switched ignition relay pin-87. After repairs are

	complete, retest for SPN 4380 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4380 FMI 2 fault code diagnostics.

Pin-Point Tests (SPN 4380 FMI 2)

(NH_3) Sensor/Module Circuit

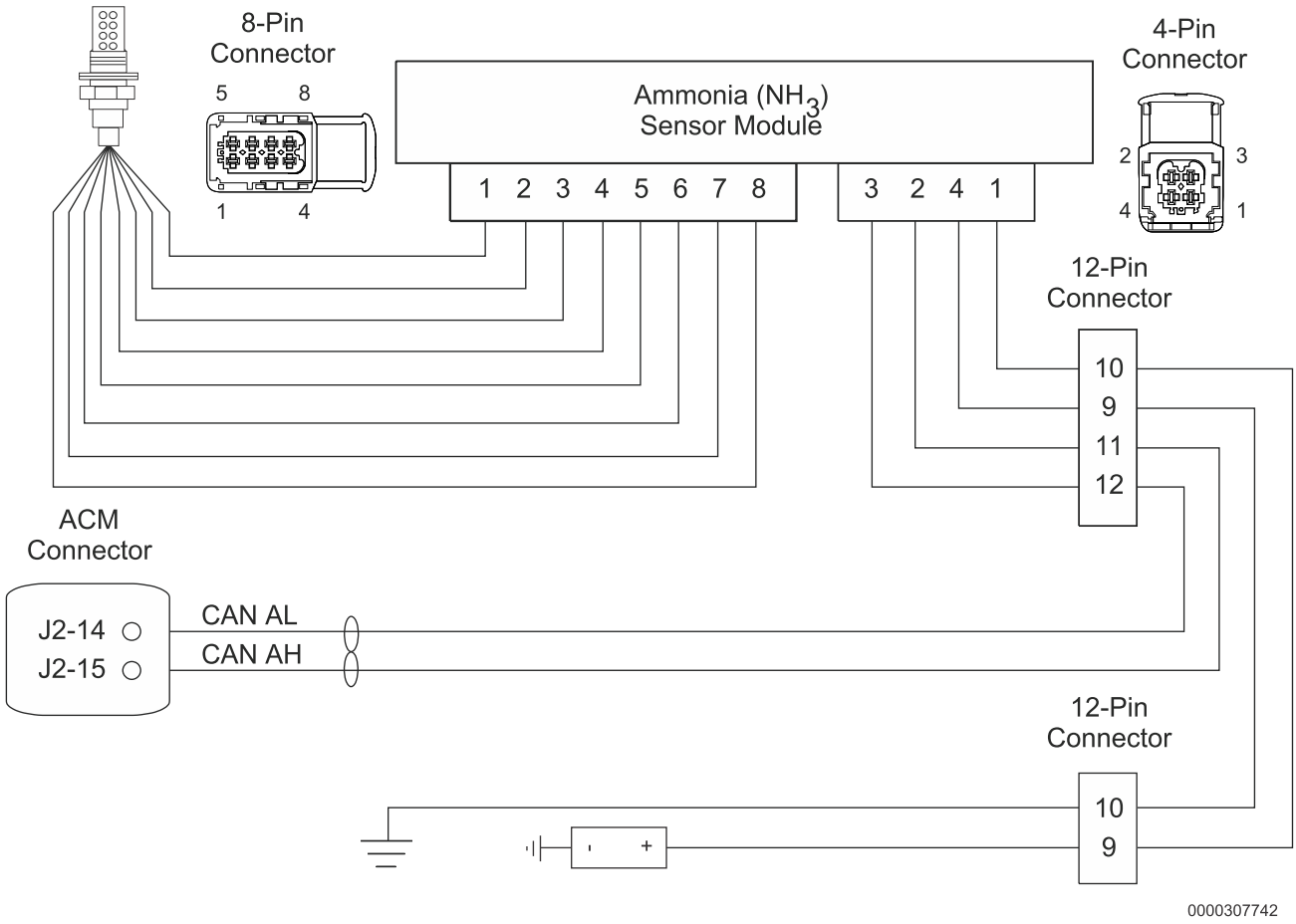
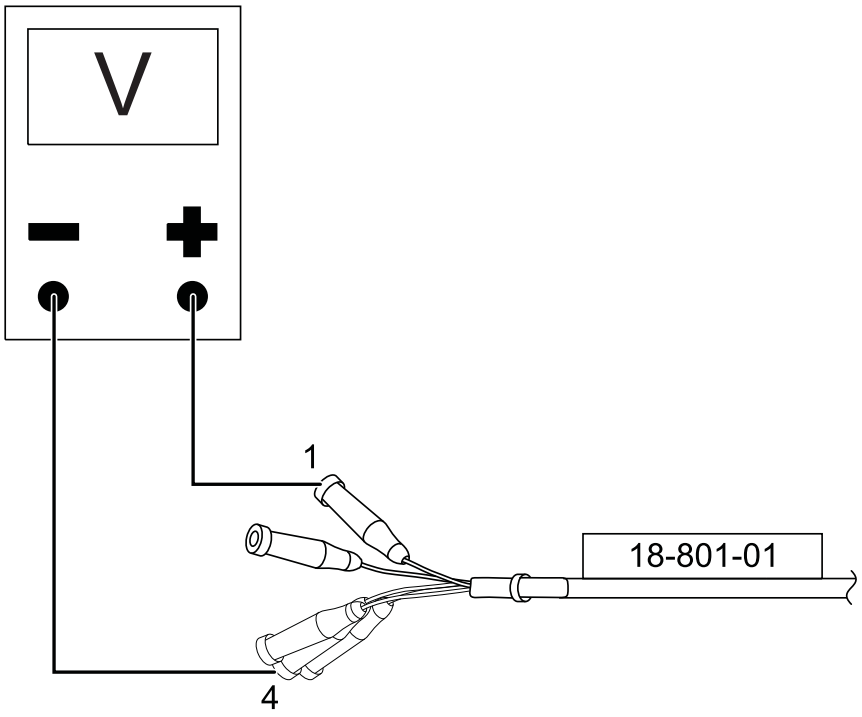


Figure 115 NH_3 Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-801-01
- Digital Multimeter (DMM)



0000308561

Figure 116 Test 1 NH_3 Sensor Circuit Voltage Check

Test 1
A. Key OFF.
B. Connect Breakout Harness 18-801-01 to vehicle harness and leave NH_3 sensor module 4-pin disconnected.
C. Key ON.

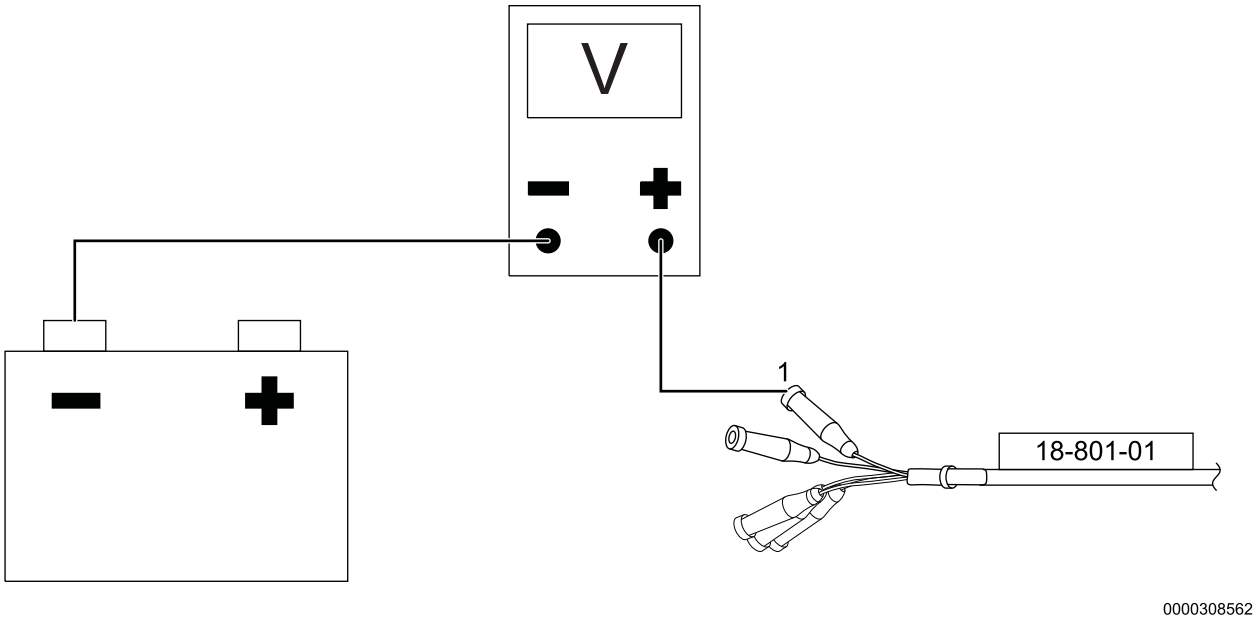


Figure 117 Test 2 NH_3 Sensor Circuit Voltage Check

Test 2
A. Key OFF.
B. Connect Breakout Harness 18-801-01 to vehicle harness and leave NH_3sensor module 4-pin disconnected.
C. Key ON.

SPN 4382 FMI 10 - NH3 sensor Heater abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Values
Ammonia (NH_3) sensor heater is unable to maintain operating temperature.	Time required for NH_3 sensor heater to meet NH_3 operating temperature after enable conditions are satisfied ≥ 120 seconds	Key ON Exhaust gas temperature measured by thermistor closest to NH_3 sensor > 320°F (160°C) for 5 seconds Exhaust flow rate < 500 g/sec Exhaust temperature at NH_3 sensor location < 1058°F (570°C) Ambient air temperature ≥ 21.2°F (-6°C) No reset on the NH_3 sensor since power up NH_3 sensor at operating temperature

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Ammonia (NH_3) sensor heater is unable to maintain its normal operating temperature for 120 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

and

• SPN 4377 FMI 4 (NH_3)	• SPN 4380 FMI 2 (NH_3)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NH_3 sensor

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 373).		Yes: Replace NH_3 sensor. After repairs are complete, retest for SPN 4382 FMI 10.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4382 FMI 10.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4382 FMI 10 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5302 FMI 18 - Post SCR NH3 Conversion Efficiency - Data Valid But Below Normal Operating Range - Moderately Severe Level

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Ammonia (NH3) conversion is less than expected.	NH3 conversion sensed at NH3 sensor module is low	Key-On Engine-Running (KOER) Selective Catalyst Reduction (SCR) outlet temperature is ≥ catalyst activation temperature SCR outlet temperature is ≤ NH3 oxidation temperature Data from NH3 sensor is valid Data from Nitrogen Oxides Outlet Concentration (NOx Out) sensor is valid Inactive: SPN 3226 (NOx Out); SPN 3228 (NOx Out); SPN 3242 (DPFIT); SPN 4360 (SCRIT); SPN 4363 (SCROT); SPN 4377 (NH3); SPN 4380 (NH3); SPN 4382 (NH3); SPN 4765 (DOCIT); SPN 5742 (DOC / DPF); and SPN 5743 (SCR)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Aftertreatment Ammonia (NH3) conversion across Selective Catalyst Reduction (SCR) catalyst is lower than expected. Engine torque will be reduced if engine is operated for an extended period of time with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3216 (NOx In); SPN 3218 (NOx In); SPN 3226 (NOx Out); SPN 3228 (NOx Out); SPN 3361 FMI 2, 3, and 4 (DEF: SP); SPN 3362 FMI 31 (DEF: SP); SPN 3363 FMI 3, 4, and 7 (DEF: THV); SPN 4334 FMI 2, 16 and 18 (DEF: AP); SPN 4340 FMI 3 and 5 (DEF: SP); SPN 4342 FMI 3 and 5 (DEF: RLH); SPN 4344 FMI 3 and 5 (DEF: SLH); SPN 4360 FMI 2, 3 and 4 (SCRIT); SPN 4363 FMI 2, 3, and 4 (SCROT); SPN 4377 (NH3); SPN 4380 (NH3); SPN 4382 (NH3); SPN 5394 FMI 5 and 7 (DEF: DU); SPN 5743 (SCR temp sensor module); SPN 520668 (AFT system); and SPN 520669 (AFT system).

Fault Facts

Aftertreatment Ammonia (NH3) sensor data is gathered over varying engine speeds and loads. When enough data has been gathered, the Aftertreatment Control Module (ACM) will make a pass or fail decision.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust system leak(s)
- Diesel Exhaust Fluid (DEF) tank, supply module, or doser valve lines or connections loose, leaking, damaged, or restricted
- Contaminated or degraded DEF
- Failed or restricted DEF Doser Unit (DEF: DU)
- Restricted DEF supply module filter
- DEF crystallization or deposits in decomposition tube
- Failed Selective Catalyst Reduction (SCR) catalyst

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3216 (NOx In), SPN 3218 (NOx In), SPN 3226 (NOx Out), and SPN 3228 (NOx Out). Is EST DTC list free of SPN 3216, SPN 3218, SPN 3226, and SPN 3228?		Yes: Go to Step 2. No: Repair SPN 3216, SPN 3218, SPN 3226, and SPN 3228. After repairs are complete, retest for SPN 5302 FMI 18.

Step 2	Check for associated fault codes.	Decision
Using EST, check DTC list for SPN 4377 (NH3), SPN 4380 (NH3), and SPN 4382 (NH3). Is EST DTC list free of SPN 4377, SPN 4380, and SPN 4382?		Yes: Go to Step 3. No: Repair SPN 4377, SPN 4380, and SPN 4382. After repairs are complete, retest for SPN 5302 FMI 18.

Step 3	Check for associated fault codes.	Decision
Using EST, check DTC list for SPN 4360 FMI 2, 3, and 4 (SCRIT); SPN 4363 FMI 2, 3, and 4 (SCROT); and SPN 5743 Selective Catalyst Reduction (SCR temp sensor module). Is EST DTC list free of SPN 4360 FMI 2, 3, and 4; SPN 4363 FMI 2, 3, and 4; and SPN 5743?		Yes: Go to Step 4. No: Repair SPN 4360 FMI 2, 3, and 4; SPN 4363 FMI 2, 3, and 4; and SPN 5743. After repairs are complete, retest for SPN 5302 FMI 18.

Step 4	Check for associated fault codes.	Decision
Using EST, check DTC list for SPN 3361 FMI 2, 3, and 4 (DEFSP); SPN 3362 FMI 31 (DEF: SP); SPN 3363 FMI 3, 4, and 7 (DEF: THV); SPN 4334 FMI 2, 16, and 18 (DEF: AP); SPN 4340 FMI 3 and 5 (DEF: SP); SPN 4342 FMI 3 and 5 (DEF: RLH); SPN 4344 FMI 3 and 5 (DEF: SLH); SPN 5394 FMI 5 and 7 (DEF: DU); SPN 520668 (AFT system); and SPN 520669 (AFT system). Is EST DTC list free of SPN 3361 FMI 2, 3, and 4; SPN 3362 FMI 31; SPN 3363 FMI 3, 4, and 7; SPN 4334 FMI 2, 16, and 18; SPN 4340 FMI 3 and 5; SPN 4342 FMI 3 and 5; SPN 4344 FMI 3 and 5; SPN 5394 FMI 5 and 7; SPN 520668; and SPN 520669?		Yes: Go to Step 5. No: Repair SPN 3361 FMI 2, 3, and 4; SPN 3362 FMI 31; SPN 3363 FMI 3, 4, and 7; SPN 4334 FMI 2, 16 and 18; SPN 4340 FMI 3 and 5; SPN 4342 FMI 3 and 5; SPN 4344 FMI 3 and 5; SPN 5394 FMI 5 and 7; SPN 520668; and SPN 20669. After repairs are complete, retest for SPN 5302 FMI 18.

Step 5	Inspect exhaust system.	Decision
Inspect exhaust system for leaks and physical damage. Is the exhaust system free of leaks and physical damage?		Yes: Go to Step 6. No: Repair leaks or physical damage. After repairs are complete, retest for SPN 5302 FMI 18.

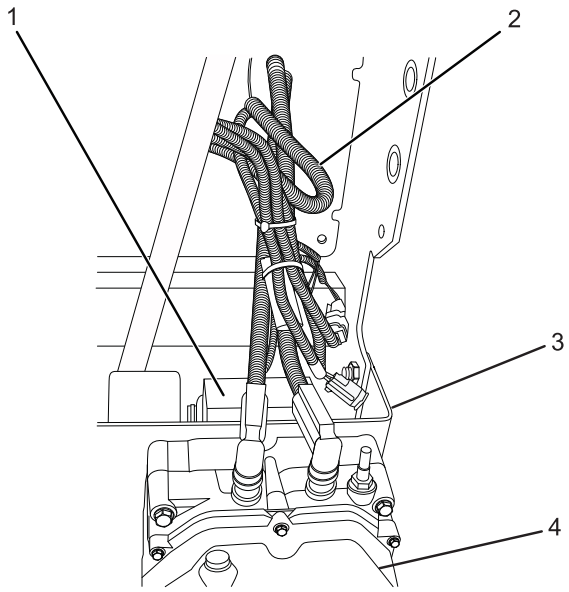


Figure 118 DEF Supply Module Location (Typical)

1. Power Distribution Module (PDM)
2. DEF lines
3. DEF tank bracket
4. DEF supply module

Step 6	Inspect lines and connections.	Decision
Check Diesel Exhaust Fluid (DEF) tank, DEF supply module, and DEF Doser Unit (DEF: DU) lines and connections for: cracks and pitting; loose, leaking, or damaged connections; and restrictions. Are DEF tank, DEF supply module, and DEF: DU lines and connections in good condition and unrestricted?		Yes: Go to Step 7. No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 5302 FMI 18.

Step 7	Check DEF quality.	Decision
Obtain sample of DEF. Visually inspect for contamination and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 to 34% and not contaminated?		Yes: Go to Step 8. Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 5302 FMI 18.

Step 8	Verify correct DEF: DU operation.	Decision
Using EST, perform the DEF Doser Pump Override Test. (page 2165) Does DEF: DU operate correctly?		Yes: Go to Step 9. No: Clean DEF supply module using 18-200-01. See DEF Supply Module Flush. If DEF: DU still does not operate correctly, replace DEF: DU. After repairs are complete, retest for SPN 5302 FMI 18.

Step 9	Check decomposition tube for crystallization.	Decision
Disconnect decomposition tube from exhaust system (see Exhaust System in the *Engine Service Manual*) and inspect for DEF crystallization. Is decomposition tube free of DEF crystallization?		Replace SCR catalyst. After repairs are complete, retest for SPN 5302 FMI 18. No: Remove DEF crystallization from decomposition tube. After repairs are complete, retest for SPN 5302 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5302 FMI 18 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

AMS (Air Management System)

Overview of AMS Sensor Group

SPN	FMI	Description
1209	0	EBP above desired level (page 382)
1209	7	EBP signal not responding as expected (page 384)
2659	10	EGR Slow Response Fault (page 386)
2659	14	EGR System flow rate error during Air Management Test (page 391)
2659	20	EGR High Flow Rate detected (page 393)
2659	21	EGR Low Flow Rate detected (page 397)

Overview

Air Management System (AMS) Tests perform testing on Exhaust Gas Recirculation (EGR) system. During test, engine speed is increased, injection timing, and Injection Control Pressure (ICP) pressure are fixed, and EGR valve is temporarily closed. As test progresses, EGR valve is opened. This test operates by monitoring Mass Air Flow (MAF) readings during test. Airflow is first measured with EGR closed, and then with EGR opened. These two measurements are then compared by Engine Control Module (ECM). If measured difference is not within minimum and maximum values expected, a code will be set.

SPN 1209 FMI 0 - EBP above desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 1209 FMI 7 - EBP signal not responding as expected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 2659 FMI 10 - EGR Slow Response Fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Recirculation (EGR) Mass Flow Rate Slow Response	Measured EGR flow rate difference from expected flow rate greater than allowed.	[1. Engine Speed > 800 rpm 2. Torque Set point > 200 N·m 3. Engine Speed gradient > -20.02 rpm/s AND <14.99 rpm/s 4. Torque Set point gradient - 5 N·m/s AND < 15 N·m/s 5. Engine Inlet Air Mass flow rate sensor set point] ≤ Moving mean value of the total air mass flow Engine Coolant Temperature 1 (ECT1) between 20°C and 103°C Barometric pressure >724 hPa Intake Manifold Temperature (IMT) between 20°C and 80°C Turbocharger #2 Compressor Inlet Temperature (TC2CIT) between 20°C and 70°C Diesel Particulate Filter (DPF) Regeneration NOT active Power Take Off (PTO) NOT active for > 5 seconds Exhaust Back Pressure valve (EBPV) NOT active for > 5 seconds Fuel cut off in engine deceleration NOT active Limp Home Mode NOT active Time after exiting Limp Home Mode > 0 SCR warm-up is NOT occurring SPN/FMI 132/3, 132/4, 172/3, 172/4, 172/2, 102/3, 102/4, 102/7, 105/3, 105/4, 105/2, 108/3, 108/4, 636/7, 636/2, 110/3, 110/4, 110/2, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3, 2791/4, 2659/21 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) determines EGR mass flow rate is low. ECM continuously monitors control system. If sensor signal is higher or lower than expected, ECM disregards signal and uses a

calibrated default value. ECM sets an SPN/FMI, turns on Warning Engine Lamp (WEL), and runs engine in a default range.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

,

• SPN 27 FMI 0 and 14 (EGR)	• SPN 51 FMI 3, 4, and 7 (ETV)	• SPN 102 FMI 2, 3, 4, 7, 10, 16, and 18 (IMP)	• SPN 105 FMI 2, 3, and 4 (IMT)
• SPN 108 FMI 2, 3, and 4 (BARO)	• SPN 110 FMI 0, 15, 16, 17, and 18 (EWPS)	• SPN 110 FMI 2, 3, and 4 (ECT1)	• SPN 132 FMI 0, 1, 3, 4, 11, 13, 14, and 31 (MAF)
• SPN 164 FMI 16 and 18 (ICP)	• SPN 651 - 656 FMI 14 (INJ)	• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)	• SPN 4257 FMI 16 and 18 (INJ)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Restricted airflow (intake or exhaust)
- Restricted EGR cooler
- Biased EBP sensor or circuit
- Plugged EBP sensor tube
- Biased IMP sensor or circuit
- EGR valve sticking closed

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 387). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2659 FMI 10.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 2659 FMI 10 status. Is EST DTC list SPN 2659 FMI 10 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3		Decision
Perform Intake Air System Inspection(page 2365). Is Intake Air System free from damage or restrictions?		Yes: Go to Step 4. No: Repair intake air system. After repairs are complete, retest for SPN 2659 FMI 10.

Step 4	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software. Ensure KOER MAF Sensor Calibration(page 2268) are met and MAF Calibration Pre-Checks are done, prior to doing this procedure. Did MAF sensor calibration run successfully?		Yes: Go to Step 5. No: Repair air intake system leaks. After repairs are complete, retest for SPN 2659 FMI 10.

Step 5	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 6. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2659 FMI 10.

Step 6	Exhaust Gas Recirculation (EGR) Operational Test.	Decision
Perform EGR Operational Test(page 2271).		Yes: Replace EGR valve. After repairs are complete, retest for SPN 2659 FMI 10.
Are there any active SPN 27 or SPN 2791 fault codes active?		No: Go to Step 7.

Step 7	Test Exhaust Back Pressure Valve (EBPV).	Decision
Perform Exhaust Back Pressure Valve (EBPV)(page 2254) Test.		Yes: Go to Step 8.
Does EBPV will cycle fully open and closed three times when key is turned off?		No: Repair EBPV as indicated by EBPV test. After repairs are complete, retest for SPN 2659 FMI 10.

Step 8	Perform Air Management Test	Decision
Perform KOER Air Management Test(page 2175).		Yes: Go to Step 9.
Does KOER Air Management Test return “Successful?		No: Repair based on results of Air Management Test. After repairs are complete, retest for SPN 2659 FMI 10.

Step 9	Analyze KOER Air Management Test results.	Decision
Analyze graphs produced by KOER Air Management Test against “Good” and “Bad” graphs		Yes: Go to Step 10.
Does test graph match “Good” graph?		No: Diagnose and repair failed actuator. After repairs are complete, repeat this step to verify repairs.

Step 10	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software, perform KOER MAF Sensor Calibration(page 2268). Ensure KOER MAF Sensor Calibration conditions are met and MAF Calibration Pre-Checks are done, prior to doing this procedure.		Yes: Replace MAF sensor. After repairs are complete, retest MAF sensor.
Did MAF sensor calibration run successfully?		No: Verify all MAF calibration requirements are met and MAF calibration pre-checks are done. Repeat MAF calibration. After repairs are complete, retest for SPN 2659 FMI 10.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 2659 FMI 10 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2659 FMI 14 - EGR System Flow Rate Error During Air Management

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 2659 FMI 10(page 386)		

Possible Causes

- EGR valve
- MAF sensor calibration
- Induction system air leaks

Step 1	Perform Air Management Test	Decision
Perform KOER Air Management Test(page 2175). Does KOER Air Management Test return “Satisfactory?		Yes: Go to Step 2. No: Perform Air Management Test Inspection.

Step 2	Do leak check of intake system.	Decision
Perform a pressure check of the intake air system. Did the intake air system pass the pressure test?		Yes: Go to Step 3. No: Repair intake air system leaks. After repairs are complete, retest for SPN 2659 FMI 14.

Step 3	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software. Ensure KOER MAF Sensor Calibration(page 2268) are met and MAF Calibration Pre-Checks are done, prior to doing this procedure. Did MAF sensor calibration run successfully?		Yes: System OK. No: Repair air intake system leaks. After repairs are complete, retest for SPN 2659 FMI 14.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 2659 FMI 14 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2659 FMI 20 - EGR High Flow Rate detected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate High Flow Monitor	Engine Air Inlet Mass Flow set point MINUS measured Mass Air Flow ≥ Threshold Value based on Speed/Torque Table (Table A041) * Engine Air Inlet Temperature modifier (Table A042) * Intake Manifold Temperature modifier (Table A043) * Coolant Temperature modifier (Table A044) * barometric pressure modifier (Table A045)	1. Monitor enable condition based on Speed/Torque based table (Table A046) 2. Monitor enable condition based on Engine Inlet Air Mass flow rate value and barometric pressure table (Table A047) Delay timer to run diagnostics after entry conditions 1 and 2 (mentioned above) are satisfied ≥ 4 seconds Particulate Filter Regeneration NOT active Power Take Off (PTO) is NOT active AND Time after PTO change of state to not active > 5 seconds End of Line tests not active Engine Exhaust Brake or Vehicle Retarder NOT active Time after Engine Exhaust Brake or Vehicle Retarder state of change to not active > 5 seconds Torque limiting in Limp Home Mode is NOT active Limp Home Mode NOT active Time after exiting Limp Home Mode > 0 SCR warm-up is NOT occurring SPN/FMI 132/3, 132/4, 172/3, 172/4, 172/2, 102/3, 102/4, 102/7, 105/3, 105/4, 105/2, 108/3, 108/4, 636/7, 636/2, 110/3, 110/4, 110/2, 651/4, 651/5, 655/4, 652/5, 653/4, 653/5, 656/4, 654/5, 652/4, 655/5, 654/4, 656/5, 3464/31, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3, 2791/4, 4752/4, 102/18 are NOT active

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 27 FMI 14 (EGR)	• SPN 51 FMI 3, 4, and 7 (ETV)	• SPN 102 FMI 2, 3, 4, 7, and 18 (IMP)	• SPN 105 FMI 2, 3, and 4 (IMT)
• SPN 108 FMI 3 and 4 (BARO)	• SPN 110 FMI 2, 3, and 4 (ECT1)	• SPN 132 FMI 3 and 4 (MAF)	• SPN 172 FMI 2, 3, and 4 (MAF)
• SPN 636 FMI 2 and 7 (CMP)	• SPN 651 - 656 FMI 4 and 5 (INJ)	• SPN 1209 FMI 0 (AMS)	• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)
• SPN 3464 FMI 31 (ETV)	• SPN 4752 FMI 4 (EGR)		

Fault Facts

Ensure that correct Programmable Parameters (PP) is programmed for air induction system.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EGR valve stuck open or damaged O-rings
- Induction system leaks
- Excessive exhaust back pressure
- MAF sensor calibration

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 394).		Yes: Go to Step 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 2659 FMI 20.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 2659 FMI 20.		Yes: Go to Step 3.
Is EST DTC list SPN 2659 FMI 20 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect Intake Air System for leaks.	Decision
Visually inspect intake air system for leaks		Yes: Repair leaks. After repairs are complete, retest for SPN 2659 FMI 20.
Are any system leaks found?		No: Go to Step 4.

Step 4	Exhaust Gas Recirculation (EGR) Operational Test.	Decision
Perform EGR Operational Test(page 2271).		Yes: Replace EGR valve. After repairs are complete, retest for SPN 2659 FMI 10.
Are there any active SPN 2791 or SPN 27 fault codes active?		No: Go to Step 6.

Step 5	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software. Ensure KOER MAF Sensor Calibration(page 2268) are met and MAF Calibration Pre-Checks are done, prior to doing this procedure.		Yes: Replace MAF sensor. After repairs are complete, retest MAF sensor.
Did MAF sensor calibration run successfully?		No: Verify all MAF calibration requirements are met and MAF calibration pre-checks are done. Repeat MAF calibration. After repairs are complete, retest for SPN 2659 FMI 10.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 2659 FMI 20 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2659 FMI 21- EGR Low Flow Rate detected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Gas Recirculation (EGR) Mass Flow Rate Low Flow Monitor	Engine Air Inlet Mass Flow set point MINUS measured Mass Air Flow ≤ Threshold Value based on Speed/Torque Table (Table A048) * Engine Air Inlet Temperature modifier (Table A049) * Intake Manifold Temperature modifier (Table A050) * Coolant Temperature modifier (Table A051) * barometric pressure modifier (Table A052)	1. Monitor enable condition based on Speed/Torque based table (Table A053) 2. Monitor enable condition based on Engine Inlet Air Mass flow rate value and barometric pressure table (Table A054) Delay timer to run diagnostics after entry conditions 1 and 2 (mentioned above) are satisfied ≥ 4 seconds Particulate Filter Regeneration NOT active Power Take Off (PTO) is NOT active AND Time after PTO change of state to not active > 5 seconds End of Line tests not active Engine Exhaust Brake or Vehicle Retarder NOT active Time after Engine Exhaust Brake or Vehicle Retarder state of change to not active > 5 seconds Torque limiting in Limp Home Mode is NOT active Torque limiting in Limp Home Mode is NOT active Limp Home Mode NOT active Time after exiting Limp Home Mode > 0 SCR warmup is NOT occurring 132/3, 132/4, 172/3, 172/4, 172/2, 102/3, 102/4, 102/7, 105/3, 105/4, 105/2, 108/3, 108/4, 636/7, 636/2, 110/3, 110/4, 110/2, 3464/31, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3, 2791/4, 2659/10, 651/14, 655/14, 653/14, 656/14, 652/14, 654/14, 110/17, 110/17, 164/18, and 164/16 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) determines EGR mass flow rate is low. ECM continuously monitors control system. If sensor signal is higher or lower than expected, ECM disregards signal and uses a calibrated default value. ECM sets an SPN/FMI, turns on Warning Engine Lamp (WEL), and runs engine in a default range.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 27 FMI 14 (EGR)	• SPN 102 FMI 3, 4, and 7 (IMP)	• SPN 105 FMI 2, 3, and 4 (IMT)	• SPN 108 FMI 3 and 4 (BARO)
• SPN 110 FMI 2, 3, and 4 (ECT1)	• SPN 132 FMI 3 and 4 (MAF)	• SPN 172 FMI 2, 3, and 4 (MAF)	• SPN 636 FMI 2 and 7 (CMP)
• SPN 2659 FMI 21 (AMS)	• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)		

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted airflow (intake or exhaust)
- Restricted EGR cooler
- Biased EBP sensor or circuit
- Plugged EBP sensor tube
- Biased IMP sensor or circuit
- EGR valve sticking closed

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 398). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2659 FMI 21.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 2659 FMI 21. Is EST DTC list SPN 2659 FMI 21 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software. Ensure KOER MAF Sensor Calibration(page 2268) are met and MAF Calibration Pre-Checks are done, prior to doing this procedure. Did MAF sensor calibration run successfully?		Yes: Go to Step 4. No: Repair air intake system leaks. After repairs are complete, retest for SPN 2659 FMI 21.

Step 4	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 5. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2659 FMI 21.

Step 5	Exhaust Gas Recirculation (EGR) Operational Test.	Decision
Perform EGR Operational Test(page 2271). Are there any active SPN 2791 or SPN 27 fault codes active?		Yes: Replace EGR valve. After repairs are complete, retest for SPN 2659 FMI 21. No: Go to Step 6.

Step 6	Visually inspect Exhaust Brake Actuator.	Decision
A. Key ON Engine Running and run for 5 seconds. B. Key OFF. C. Visually inspect Exhaust Brake Actuator.		Yes: Go to Step 9.
Does Exhaust Brake Actuator cycle open and closed 3 times?		No: Go to Step 7.

Step 7	Check for air pressure leaks from Exhaust Brake Actuator supply line.	Decision
A. Disconnect air supply to Exhaust Brake Actuator. B. Key ON Engine Running and run for 5 seconds. C. Key OFF. D. Listen to Exhaust Brake Actuator supply line for air pressure leakage.		Yes: Replace Exhaust Brake Housing. After repairs are complete, retest for SPN 2659 FMI 21.
Does Exhaust Brake Actuator air supply line leak air pressure?		No: Go to Step 8.

Step 8	Verify air pressure leakage from Exhaust Brake Control Valve air supply line.	Decision
A. Verify vehicle air pressure is 60 psi or greater. B. Disconnect Exhaust Brake Control Valve air supply line.		Yes: Replace Exhaust Brake Control valve. After repairs are complete, retest for SPN 2659 FMI 21.
Does Exhaust Brake Control Valve air supply leak air pressure?		No: Repair Exhaust Brake Control Valve air pressure supply line. After repairs are complete, retest for SPN 2659 FMI 21.

Step 9		Decision
Perform KOER Air Management Test(page 2175).		Yes: Go to Step 10.
Does KOER Air Management Test return “Satisfactory?		No: Diagnose and repair failed actuator. After repairs are complete, retest for SPN 2659 FMI 21.

Step 10	Do Mass Air Flow (MAF) Calibration Procedure.	Decision
Using ServiceMaxx™ software. Ensure KOER MAF Sensor Calibration(page 2268) are met and MAF Calibration Pre-Checks are done, prior to doing this procedure. Did MAF sensor calibration run successfully?		Yes: Replace MAF sensor. After repairs are complete, retest for SPN 2659 FMI 21. No: Verify all MAF calibration requirements are met and MAF calibration pre-checks are done. Repeat MAF calibration. After repairs are complete, retest for SPN 2659 FMI 21.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 2659 FMI 21 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

APP Sensor (Accelerator Pedal Position)

Overview of APP Sensor Group

SPN	FMI	Description
91	2	APP1 and APP2 signal conflict (page 403)
91	3	APP1 signal Out of Range HIGH (page 405)
91	4	APP1 signal Out of Range LOW (page 409)
2623	3	APP2 signal Out of Range HIGH (page 416)
2623	4	APP2 signal Out of Range LOW (page 421)

Overview

Accelerator Pedal Position (APP) sensor is controlled by operator. Engine Control Module (ECM) uses this sensor to control engine output based on operator's demand for power.

SPN 91 FMI 2 APP1 and APP2 signal conflict

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 91 FMI 3 - APP1 signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Accelerator Pedal Position 1 (APP1) signal greater than expected.	APP1 signal > 4.575 volts	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Accelerator Pedal Position 1 (APP1) signal is greater than 4.575 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3510 FMI 3 and 4 (VREF 2)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- APP1 circuit short to PWR
- SIG GND circuit Open
- Failed APP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 405). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 91 FMI 3.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 91 FMI 3. Is EST DTC list SPN 91 FMI 3 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Accelerator Pedal Position (APP) sensor.	Decision
A. Key OFF. B. Disconnect APP sensor and connector. C. Check APP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the APP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 91 FMI 3.

Pin-Point Tests (SPN 91 FMI 3)

APP Circuit

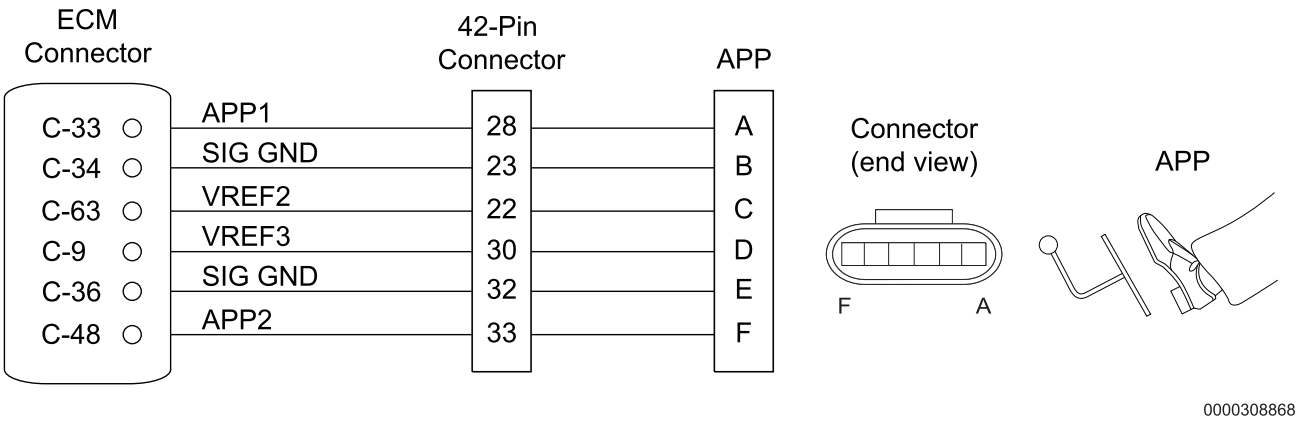


Figure 122 APP Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Check for short to PWR.	Decision
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.		Yes: Repair short to PWR between APP sensor connector pin-A and Engine Control Module (ECM) pin C-33. After repairs are complete, retest for SPN 91 FMI 3.
Does SPN 91 FMI 3 set after DTC list is cleared?		No: Go to Test 2.

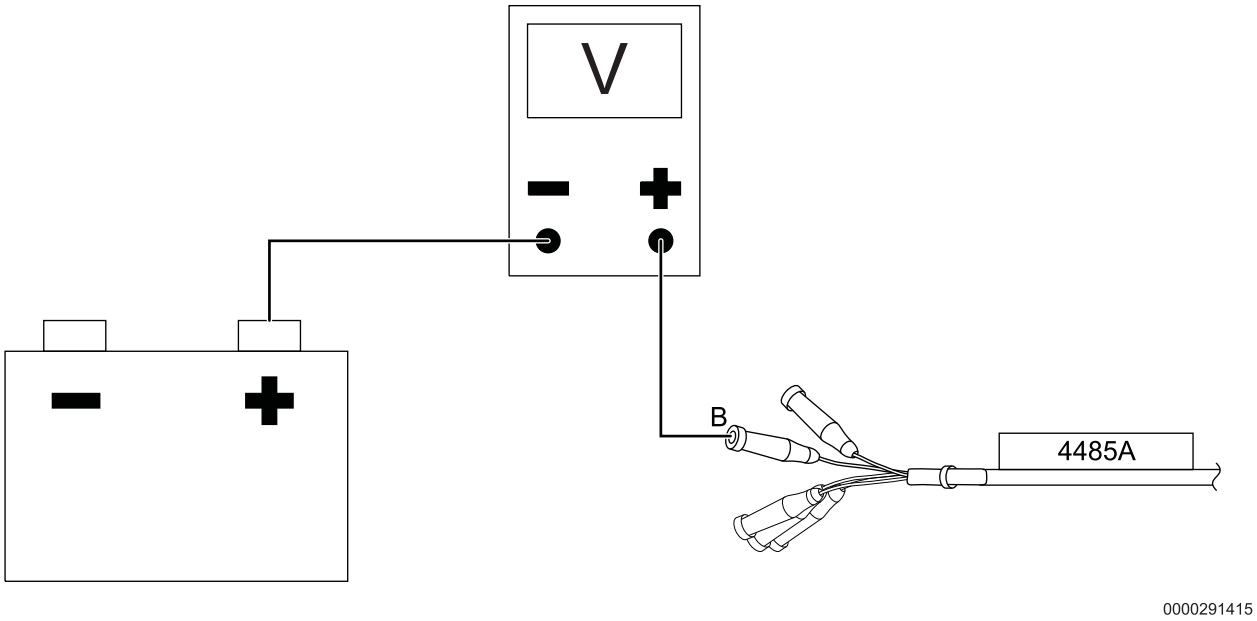


Figure 123 Test 2 APP1 Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4435A to vehicle harness and leave APP sensor disconnected. C. Key ON.

Test 2	Check for Opens.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-B and PWR. Is voltage B+ ± 0.5 volts?		Yes: Replace APP sensor. After repairs are complete, retest for SPN 91 FMI 3. No: Repair Open between APP pin-B and ECM pin C-34. After repairs are complete, retest for SPN 91 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 91 FMI 3 fault code diagnostics.

SPN 91 FMI 4 - APP1 signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
APP1 signal less than expected.	APP1 signal less than 0.825 volts	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Accelerator Pedal Position 1 (APP1) signal is less than 0.825 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3510 FMI 3 and 4 (VREF 2)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON

Possible Causes

- APP1 signal circuit Open
- APP1 VREF circuit Open
- APP1 signal circuit short to GND
- Failed APP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 409). Is EST DTC list free of SPN 3510 FMI 3 and 4?		Yes: Go to Step 2. No: Repair SPN 3510 FMI 3 and 4. After repairs are complete, retest for SPN 91 FMI 4.

Step 2	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 4. Does EST DTC list show SPN 94 FMI 4 as Active or Pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Accelerator Pedal Position (APP) sensor.	Decision
A. Key OFF. B. Disconnect APP sensor connector. C. Check APP1 sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the APP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 91 FMI 4.

Pin-Point Tests (SPN 91 FMI 4)

APP Circuit

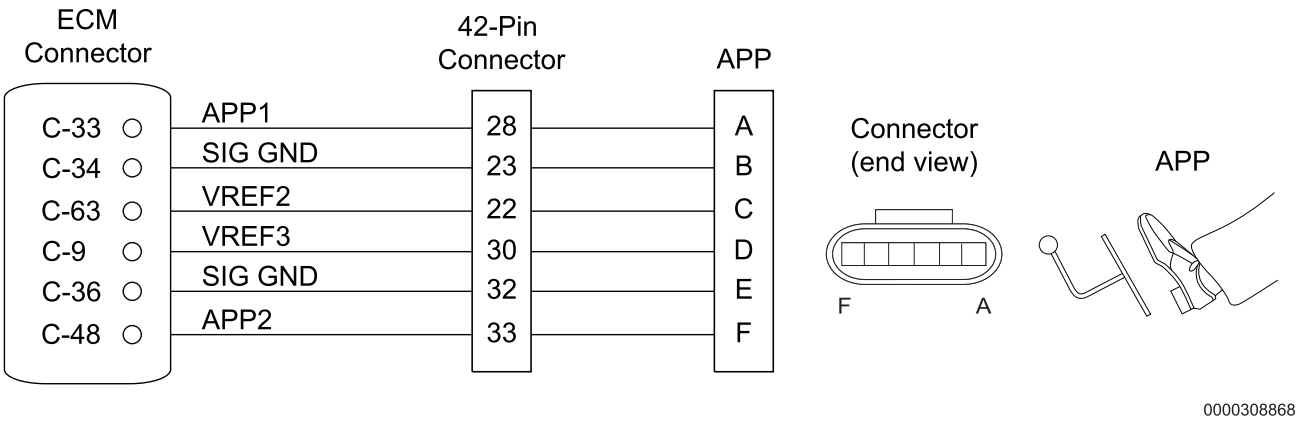


Figure 124 APP1 Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

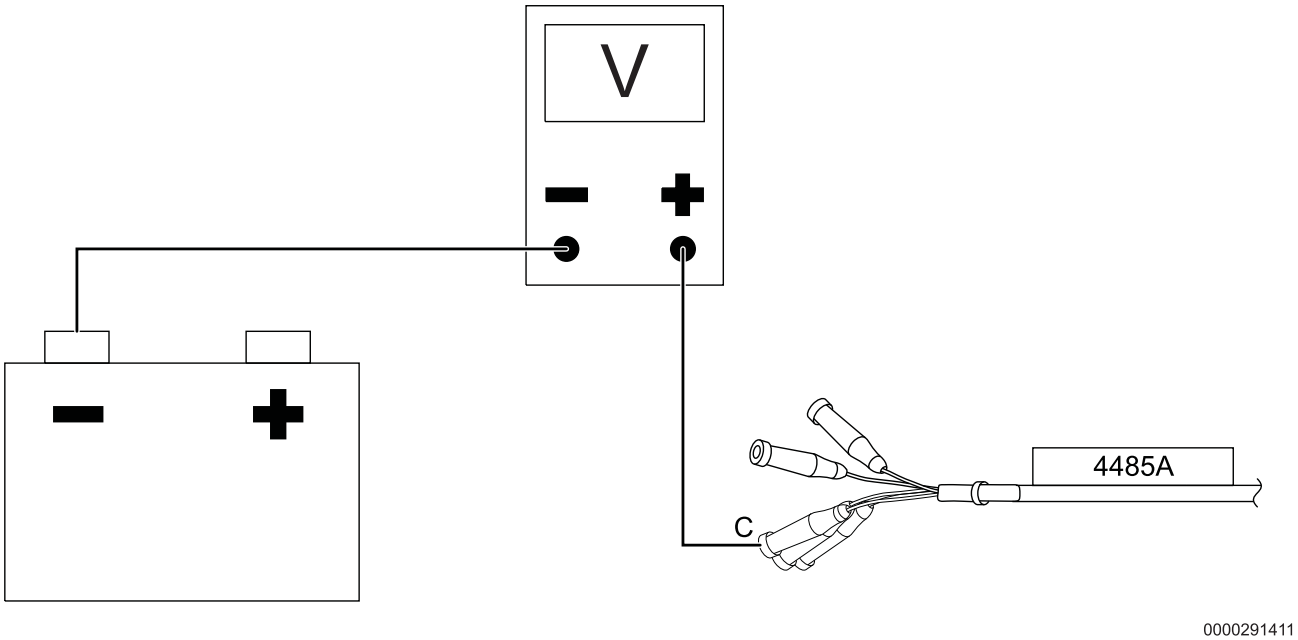
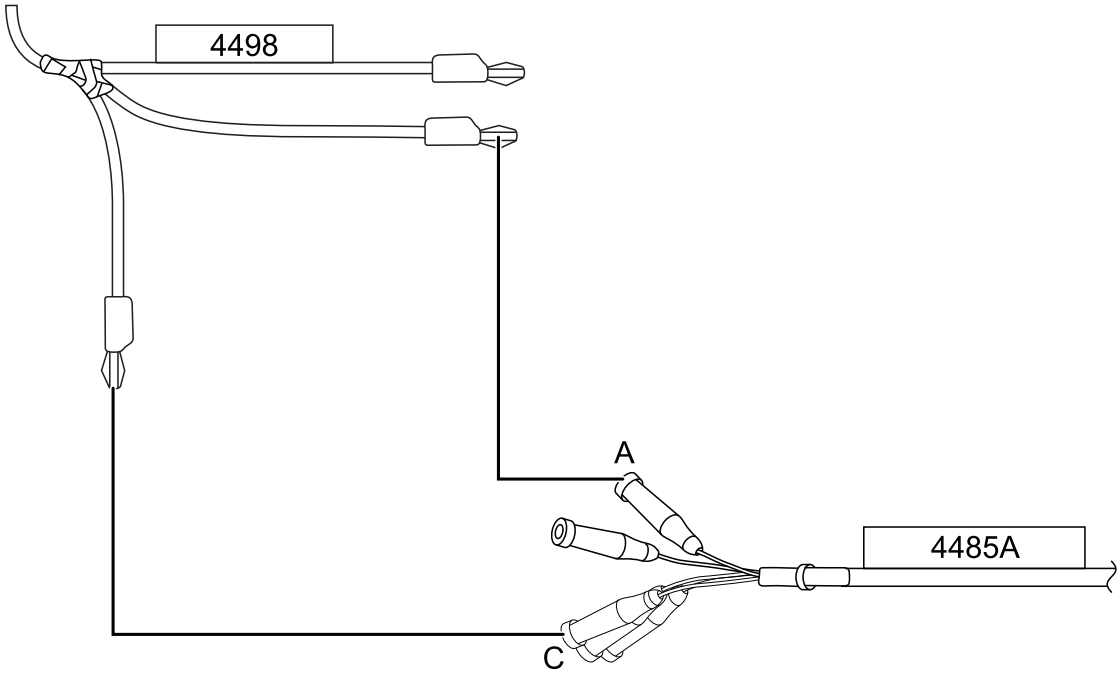


Figure 125 Test 1 APP1 Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to Accelerator Pedal Position (APP) and leave sensor disconnected. C. Key ON.

Test 1	Check for Opens to APP sensor.	Decision
Using DMM, measure voltage between Breakout Harness ZTSE4485A pin C and a known good GND. Is voltage 5 volts ± 1 volt?		Yes: Go to Test 2. No: Repair Open between APP sensor connector pin-C and Engine Control Module (ECM) 76-pin chassis connector pin C-63. After repairs are complete, retest for SPN 91 FMI 4.

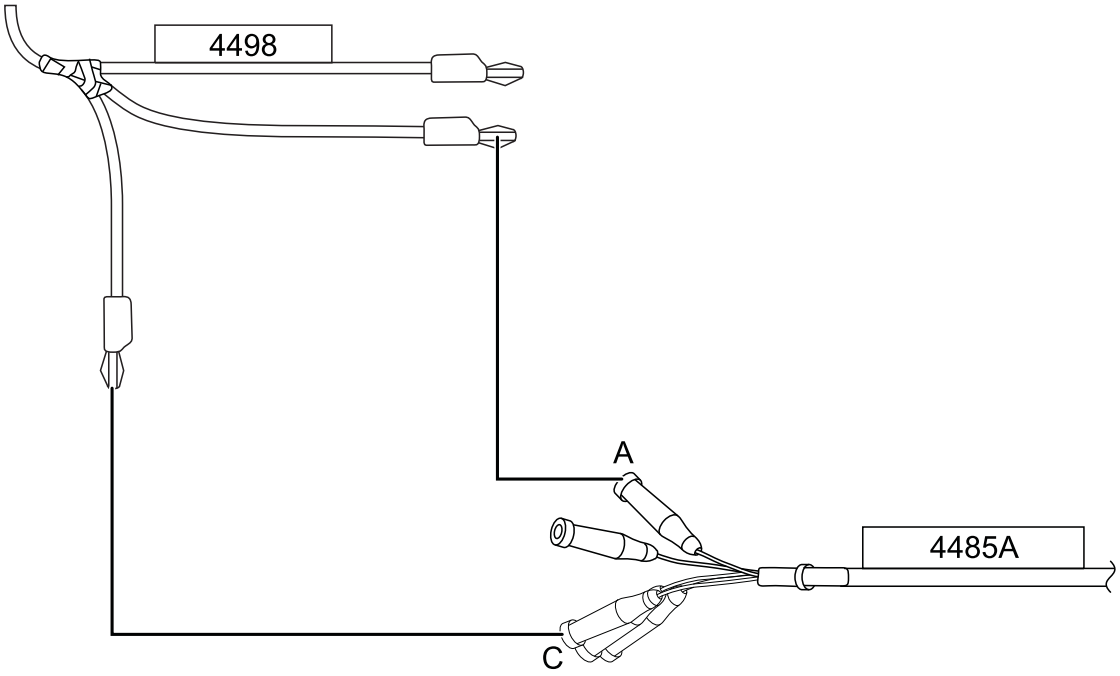


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Figure 126 Test 2 APP1 Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to Accelerator Pedal Position (APP) and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-A and pin-C of Breakout Harness ZTSE4485A together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2		Decision
Clear Diagnostic Trouble Code (DTC) list using EST with ServiceMaxx™ software.		Yes: Replace Accelerator Pedal Position (APP) sensor. After repairs are complete, retest for SPN 91 FMI 4.
Does SPN 91 FMI 3 set after DTC list is cleared?		No: Go to Test 3.



0000306439

Figure 127 Test 3 APP1 Circuit Check

Test 3 Setup
A. Key OFF.
B. Connect Breakout Harness ZTSE4485A to Accelerator Pedal Position (APP) and leave sensor disconnected.
C. Using Breakout Harness ZTSE4498, short pin-A and pin-C of Breakout Harness ZTSE4485A together.
D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Check for short to GND on APP sensor.	Decision
Clear Diagnostic Trouble Code (DTC) list using EST with ServiceMaxx™ software.		Yes: Repair short to GND between APP sensor pin A and Engine Control Module (ECM) pin C-33. After repairs are complete, retest for SPN 91 FMI 4.
Does SPN 3511 FMI 4 set after DTC list is cleared?		No: Repair Open between APP sensor pin A and ECM pin C-33. After repairs are complete, retest for SPN 91 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 91 FMI 4 fault code diagnostics.

SPN 2623 FMI 3 - APP2 Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Accelerator Pedal Position (APP) signal is greater than expected.	APP2 signal > 2.476 volts	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that APP2 voltage is greater than 2.476 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- APP2 circuit short to PWR
- SIG GND circuit Open
- Failed APP sensor

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 2623 FMI 3.		Yes: Go to Step 2.
Does EST DTC list show SPN 2623 FMI 3 as active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Accelerator Pedal Position (APP) sensor connector	Decision
A. Key OFF. B. Disconnect APP sensor connector. C. Check APP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Perform Pin-Point Tests.
Are the APP sensor connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2623 FMI 3.

Pin-Point Tests (SPN 2623 FMI 3)

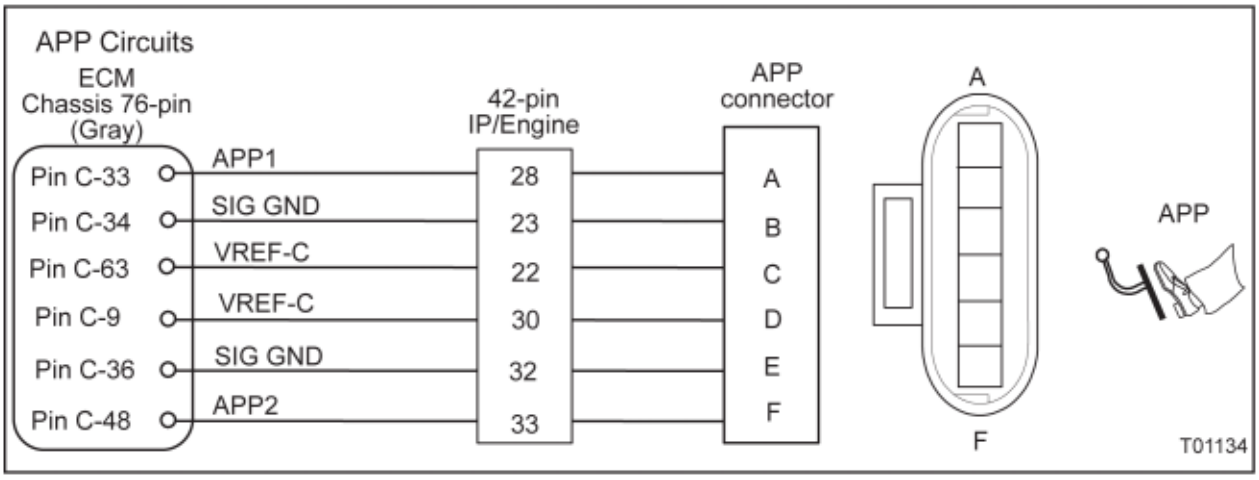


Figure 128 Accelerator Pedal Position (APP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor C. Key ON.

Test 1	Check for short to PWR on APP sensor.	Decision
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.		Yes: Go to Test 2.
Does fault code SPN 2623 FMI 4 set?		No: Repair short to PWR between APP connector pin-F and Engine Control Module (ECM) connector pin C-48.

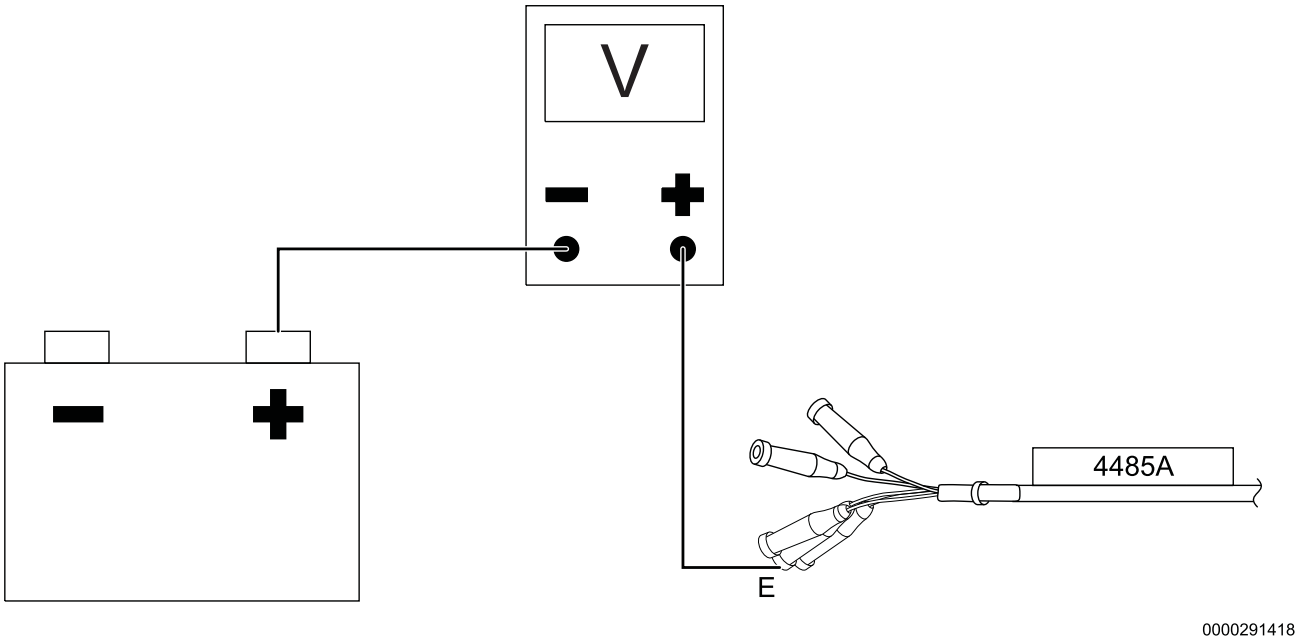


Figure 129 Test 2 Accelerator Pedal Position (APP2) Sensor Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to Accelerator Pedal Position (APP) sensor vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 2	Check for Open in APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-E and B+. Is voltage 12 volts ± 1 volt?		Yes: Replace APP sensor. After repairs are complete, retest for SPN 2623 FMI 3. No: Repair Open between APP sensor connector pin-E and ECM connector pin C-36. After repairs are complete, retest for SPN 2623 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 2623 FMI 3 fault code diagnostics.

SPN 2623 FMI 4 - APP2 Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Accelerator Pedal Position 2 (APP2) signal is lower than expected.	APP2 signal < 0.273 volt	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Accelerator Pedal Position (APP) sensor is reading lower than 0.273 volt on APP2 signal circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3511 FMI 3 and 4 (VREF 3)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- APP2 circuit Open
- APP2 circuit short to GND
- VREF3 circuit Open
- Failed APP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 421). Does EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2623 FMI 4.

Step 2	Inspect connections at Accelerator Pedal Position (APP) sensor connector	Decision
A. Key OFF. B. Disconnect APP sensor connector. C. Check APP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the APP sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2623 FMI 4.

Pin-Point Tests (SPN 2623 FMI 4)

APP Circuit

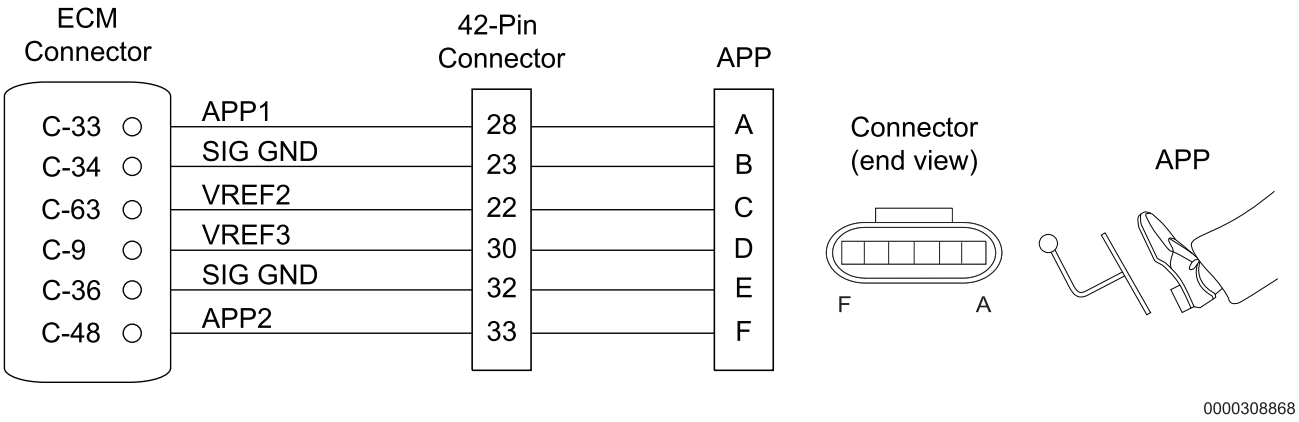


Figure 130 Accelerator Pedal Position (APP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-Pin Breakout Box 00-00956-08
- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

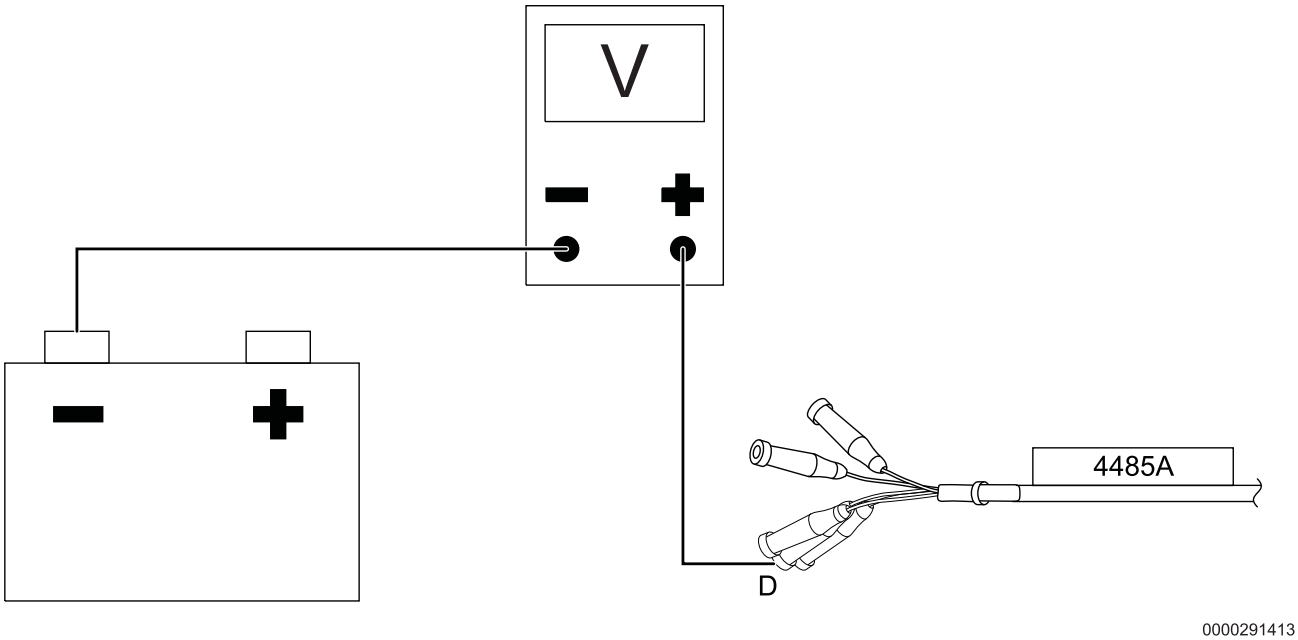
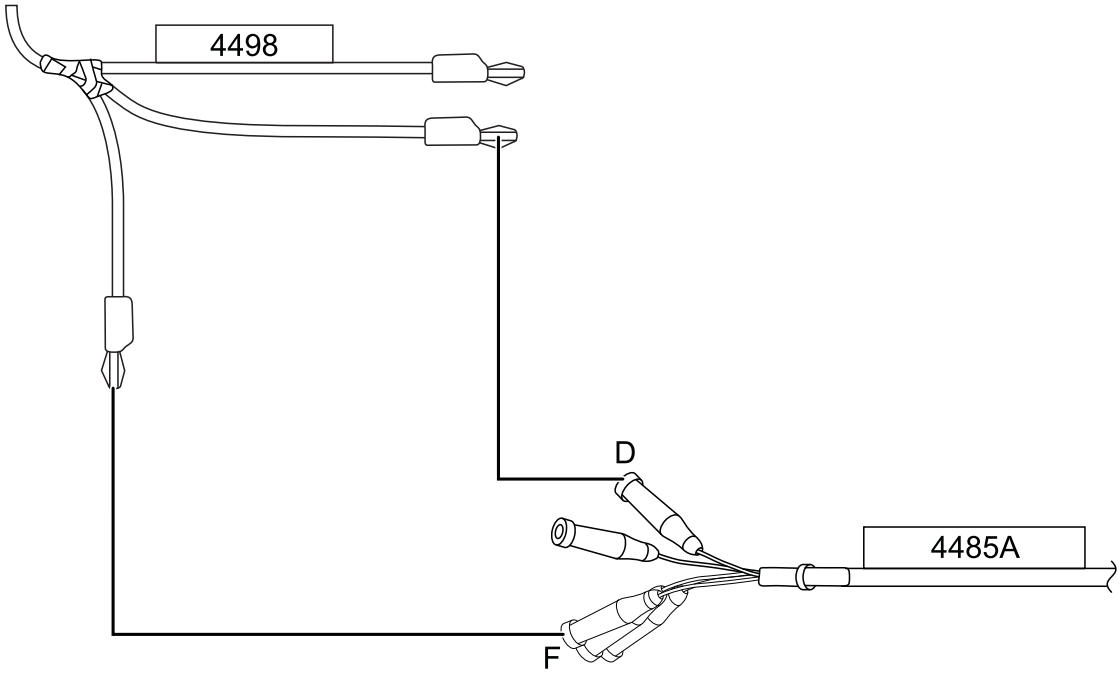


Figure 131 Test 1 APP Sensor Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to Accelerator Pedal Position (APP) sensor vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Check for Open in APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and a known good ground. Is voltage 5 volts ± 1 volt?		Yes: Go to Test 2. No: Repair Open between APP sensor connector pin-D and Engine Control Module (ECM) connector pin C-9. After repairs are complete, retest for SPN 2623 FMI 4.

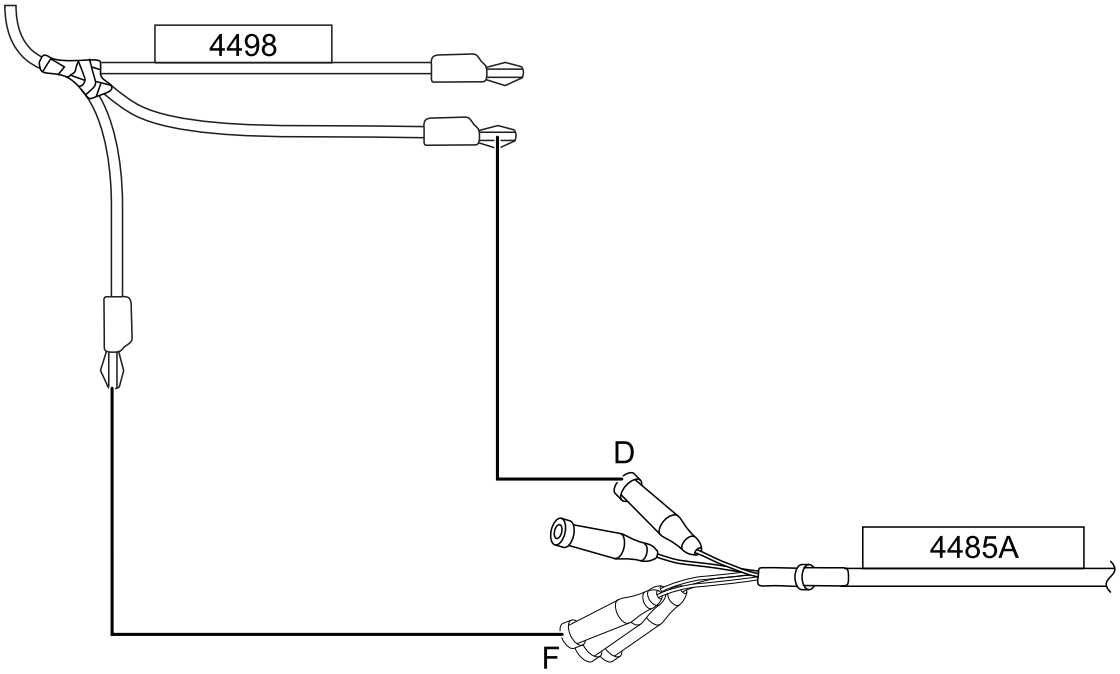


0000307556

Figure 132 Test 2 APP Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to APP sensor vehicle harness connector and leave sensor disconnected. C. Using ZTSE4498 short pin-D to pin-F. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic (page 2124). E. Key ON. Log on to ServiceMaxx™ software.

Test 2		Decision
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.		Yes: Replace APP sensor. After repairs are complete, retest for SPN 2623 FMI 3.
Does SPN 2623 FMI 3 become active or pending in DTC list?		No: Go to Test 3.



0000307556

Figure 133 Test 3 APP Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4485A to APP sensor vehicle harness connector and leave sensor disconnected. C. Using ZTSE4498 short pin-D to pin-F. D. Connect EST to vehicle Diagnostic. E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Check for short to GND in APP sensor.	Decision
Using EST with ServiceMaxx™ software, clear DTC list.		Yes: Repair short to GND between APP pin-F and ECM pin C-48. After repairs are complete, retest for SPN 2623 FMI 4.
Does SPN 3511 FMI 4 become active or pending in DTC list?		No: Repair Open between APP pin-F and ECM pin C-48. After repairs are complete, retest for SPN 2623 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 2623 FMI 4 fault code diagnostics.

Body

Overview of Body Sensor

SPN	FMI	Description
521	2	Brake applied while APP applied (page 429)
596	19	Cruise Control Enable Switch not detected on J1939 (page 431)
597	2	Brake switch or circuit fault (page 433)
597	19	Brake switch not detected on J1939 (page 435)

Overview

The ECM receives inputs from various chassis mounted sensors and switches, and uses the signals to monitor the operating conditions of the vehicle.

SPN 521 FMI 2 - Brake applied while APP applied

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Brake applied while APP applied	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 91 FMI 2 (APP)	• SPN 597 FMI 2 (Body)	• SPN 597 FMI 19 (Body)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Operator applied accelerator and brake pedal at the same time
- APP1 sensor or circuit fault
- Brake Pedal switch or circuit fault

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 429). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 521 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using EST with ServiceMaxx™ software. Key ON, check DTC list for SPN 521 FMI 2. Is EST DTC list SPN 521 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check break switch operation.	Decision
A. Key OFF. B. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). C. Open Driver Switch Control Session in ServiceMaxx™ software to monitor signals. D. Depress the brake pedal.		Yes: Go to Step .
Did the Brake Switch signal change to "applied" when depressed, and "released" when lifted?		No: Go to Step 4.

Step 4	Inspect connections at Brake Pedal Switch and Body Controller connectors.	Decision
A. Key OFF. B. Disconnect Brake Pedal Switch and Body Controller connectors. C. Check Brake Pedal Switch and Body Controller and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 5.
Are Brake Pedal Switch and Body Controller connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 521 FMI 2.

SPN 596 FMI 19 Cruise Control Enable Switch not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Cruise Control Enable Switch not detected on J1939	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 597 FMI 19 (Body)	• SPN 639 FMI 14 (J1939)		

Fault Facts

The cruise control switches are wired to the Body Controller (BC). The switch state is communicated to the ECM through the J1939 Data Link Network.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Cruise Control switch or circuit fault
- Incorrect programmable Parameter setting

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 431). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 596 FMI 19.

Step 2	Verify Cruise Control programmable parameters.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, open the programming session file and verify that all Parameters are set correctly. Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 596 FMI 19.

SPN 597 FMI 2 - Brake switch or circuit fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 597 FMI 19 - Brake switch not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Brake Switch not detected on J1939	TBD	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) signal is out of range high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Brake switches can be wired to Engine Control Module (ECM), or to Body Controller (BC). If wired to BC, switch state is communicated to ECM through J1939 Data Link Network. PP89021 in ECM determines where ECM should expect signal from.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- None

Step 1	Check for communication with Body Controller	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Sniffer section for Body Controller. A. Key OFF. B. Disconnect TOSS/VSS sensor. C. Check TOSS/VSS sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Perform Pin-Point Tests.
Are TOSS/VSS sensor connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 191 FMI 3.

Pin-Point Tests (SPN 191 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

Test 1 Setup
A. Key OFF. B. Disconnect TOSS/VSS sensor connector. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into TOSS/VSS vehicle harness and leave TOSS/VSS disconnected. D. Key ON.

Test 1	Check for short to B+	Decision
Use DMM to measure voltage between TOSS/VSS vehicle harness pin-1 and known good GND. Is voltage less than 1.7 volts?		Yes: Repair short to B+ in TOSS-L circuit. After repairs are complete, retest for SPN 191 FMI 3. No: Repair short to B+ in TOSS-H circuit. After repairs are complete, retest for SPN 191 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 597 FMI 19 fault code diagnostics.

CACOT Sensor (Charge Air Cooler Outlet Temperature)

Overview of CACOT Sensor Group

SPN	FMI	Description
2630	2	CACOT signal erratic, intermittent, or incorrect (page 440)
2630	3	CACOT signal Out of Range HIGH (page 446)
2630	4	CACOT signal Out of Range LOW (page 452)
2630	16	CACOT Undercooling (page 456)

Overview

Charge Air Cooler Outlet Temperature (CACOT) is a thermistor sensor that measures charged-air temperature entering Engine Throttle Valve (ETV). As temperature increases, resistance drops, causing voltage signal interpreted by Engine Control Module (ECM) to vary. ECM monitors this signal for Exhaust Gas Recirculation (EGR) system control and CAC performance.

SPN 2630 FMI 2 - CACOT signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Charge Air Cooler Outlet Temperature (CACOT) does not agree with other sensors	Difference between CACOT temperature and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, TC2CIT, IMT, IAT, and EOT are all within 59°F (15°C) of each other

Fault Overview

Fault code sets when ECM detects that Charge Air Cooler Outlet Temperature (CACOT) sensor does not agree with other temperature sensors.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 2630 FMI 3 and 4 (CACOT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (after cold soak)

Possible Causes

- Failed CACOT sensor
- High resistance in CACOT circuit
- High resistance in SIG GND circuit

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 440). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2630 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using EST with ServiceMaxx™ software. Key ON, check DTC list for SPN 2630 FMI 2. Is EST DTC list SPN 2630 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Charge Air Cooler Outlet Temperature (CACOT) connector.	Decision
A. Key OFF. B. Disconnect CACOT connector. C. Check CACOT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are CACOT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2630 FMI 2.

Pin-Point Tests (SPN 2630 FMI 2)

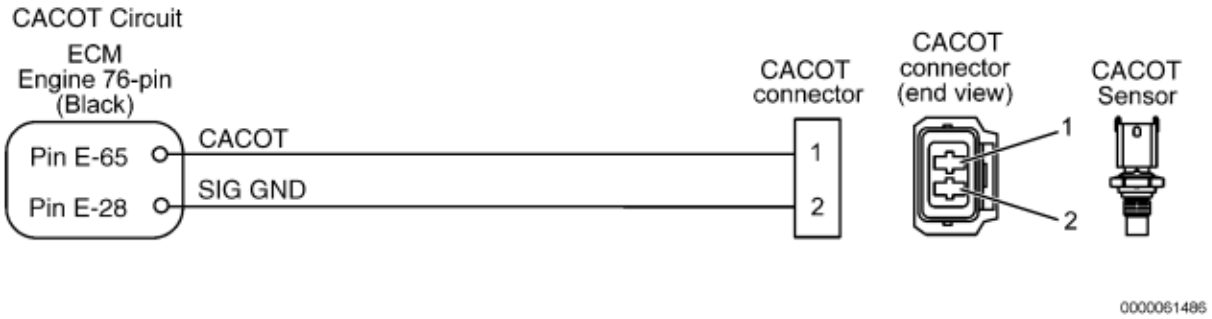
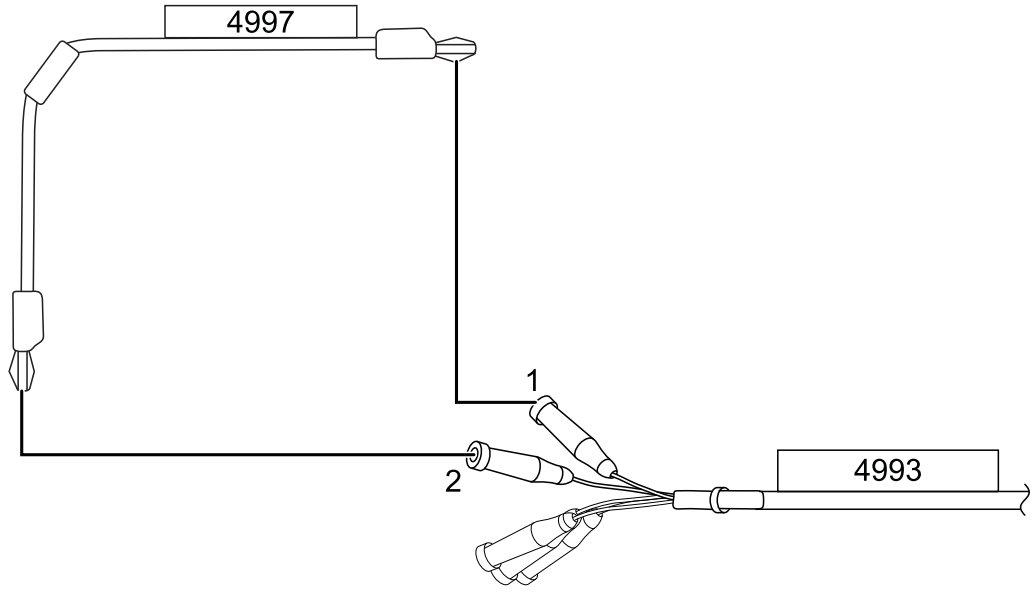


Figure 135 Charge Air Cooler Outlet Temperature (CACOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4993
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334581

Figure 136 Test 1 CACOT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Outlet Temperature (CACOT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave CACOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor charge air cooler outlet temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace CACOT sensor. After repairs are complete, retest for SPN 2630 FMI 2.
	No: Go to Test 2.

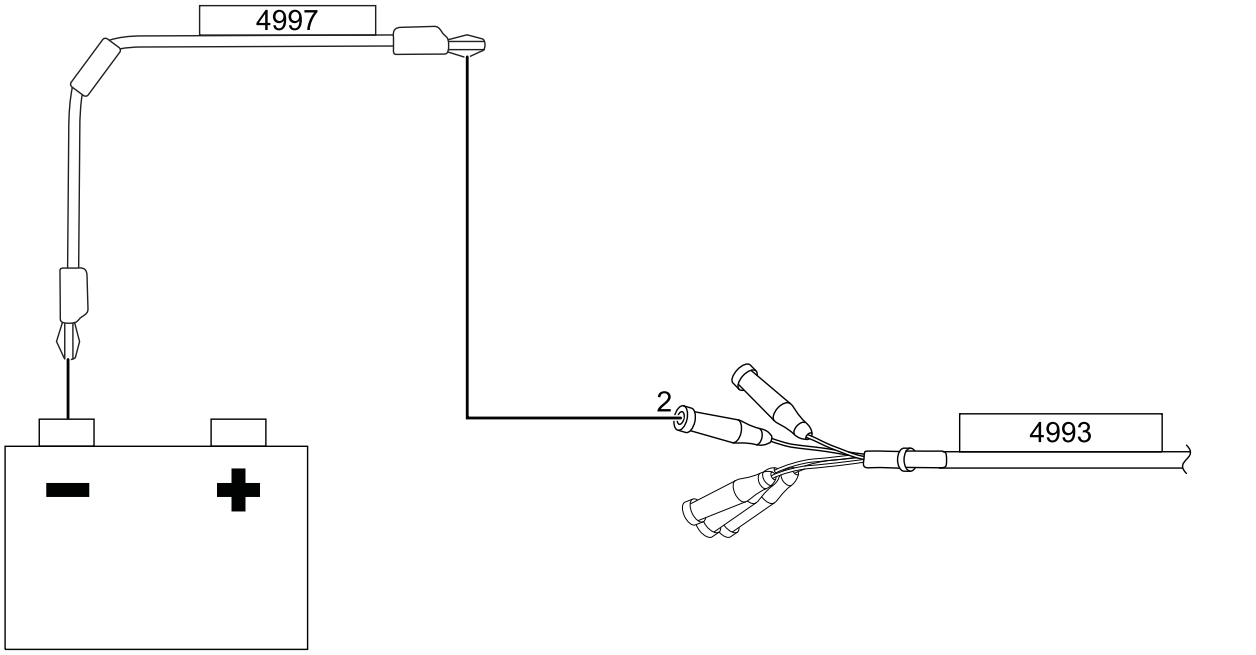


Figure 137 Test 2 CACOT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Outlet Temperature (CACOT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave CACOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor charge air cooler outlet temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace SIG GND circuit between CACOT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 2630 FMI 2.
	No: Replace SIG circuit between CACOT pin-2 and ECM pin E-65. After repairs are complete, retest for SPN 2630 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 2630 FMI 2 fault code diagnostics.

SPN 2630 FMI 3 - CACOT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Charge Air Cooler Outlet Temperature (CACOT) sensor voltage reading greater than expected.	CACOT sensor voltage < 4.70 volt {< -53°F (-47°C)}	Key ON

Fault Overview

Fault Code sets when Engine Control Module (ECM) detects Charge Air Cooler Temperature (CACOT) sensor voltage is greater than 4.70 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected after two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- CACOT circuit short to PWR
- CACOT circuit Open
- SIG GND circuit Open
- Failed component

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 2630 FMI 3. Is EST DTC list SPN 2630 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at CACOT	Decision
A. Key OFF. B. Disconnect Charge Air Cooler Outlet Temperature (CACOT) sensor. C. Check CACOT sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are CACOT sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2630 FMI 3.

Pin-Point Tests (SPN 2630 FMI 3)

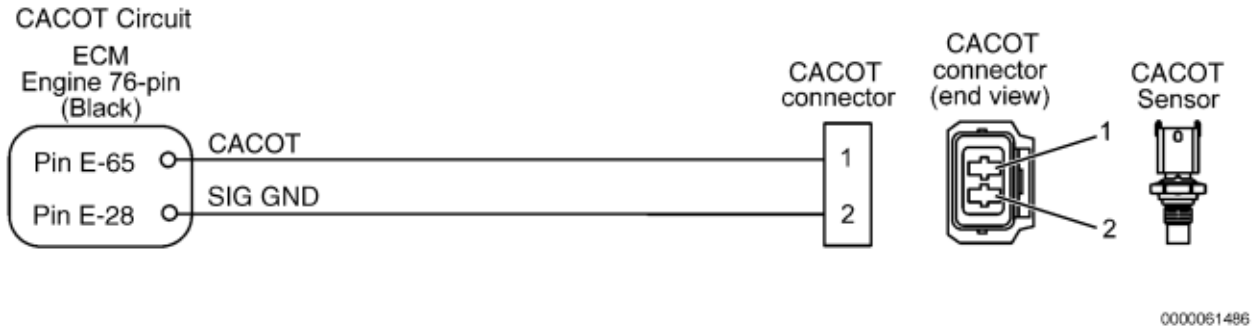


Figure 138 Charge Air Cooler Temperature (CACOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4498
- Breakout Harness ZTSE4993
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

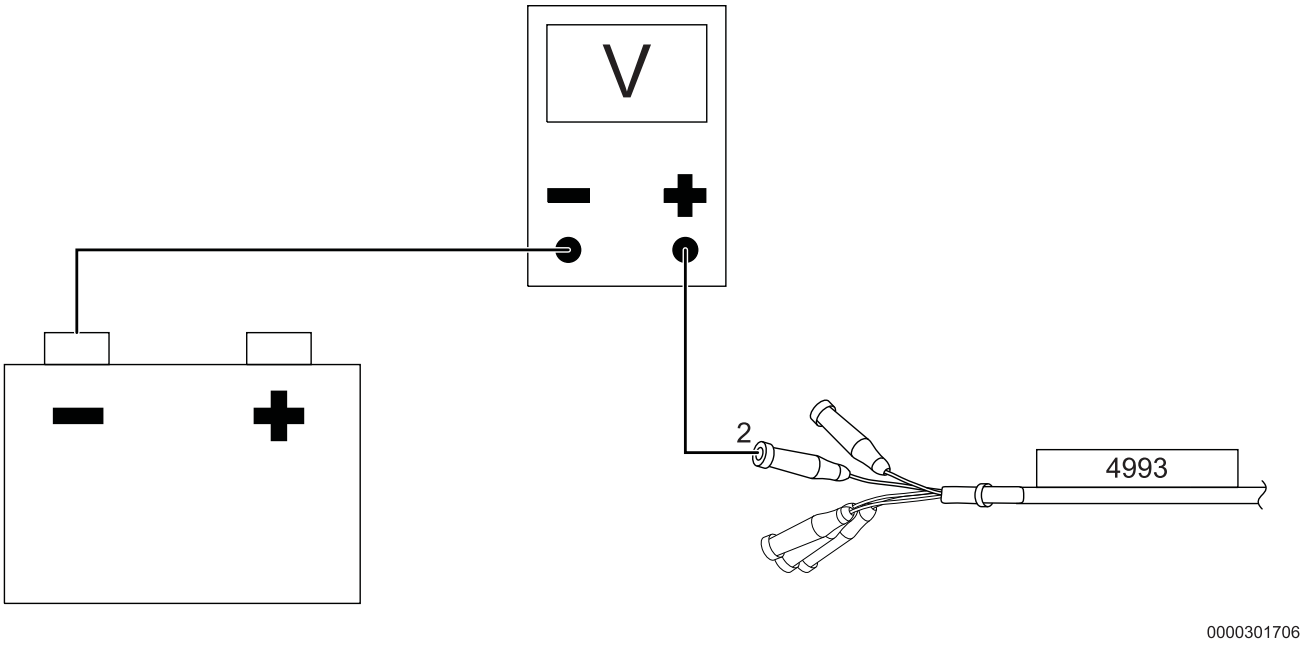
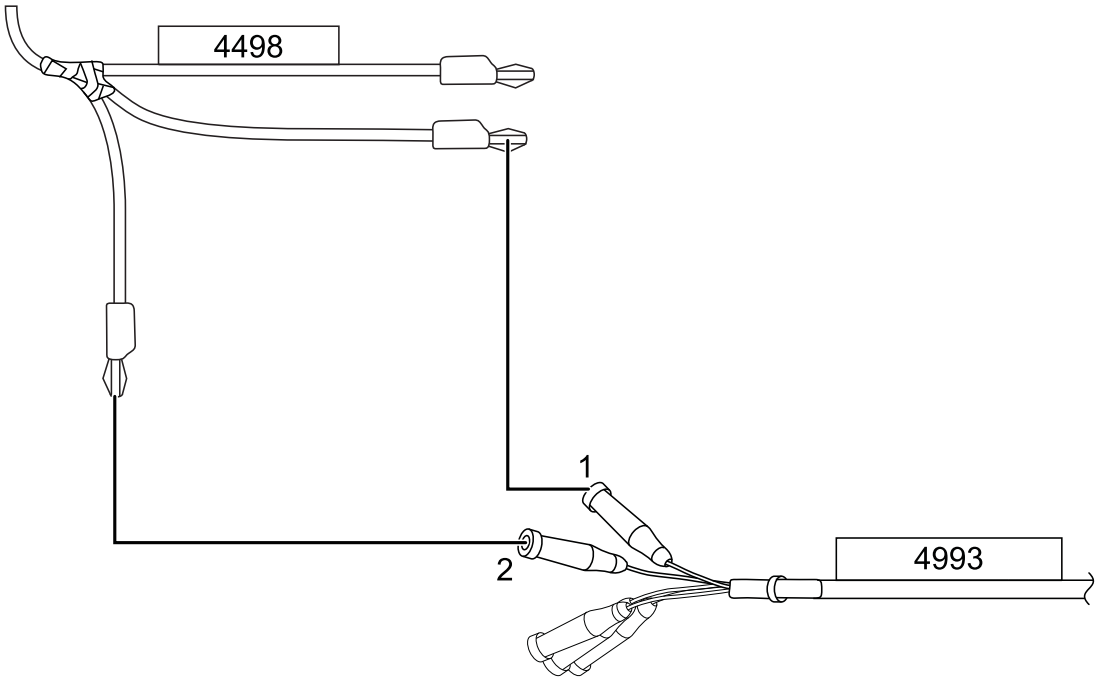


Figure 139 Test 1 CACOT Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Temperature (CACOT) sensor C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave CACOT disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4993 pin-2 and known good GND.	Greater than 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to PWR between Engine Control Module (ECM) pin E-65 and CACOT pin-2. After repairs are complete, retest for SPN 2630 FMI 3.
	No: Go to Test 2.



0000301703

Figure 140 Test 2 SIG GND Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Temperature (CACOT) sensor C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave CACOT disconnected. D. Using Breakout Harness ZTSE4498 short Breakout Harness ZTSE4993 pin-1 and pin-2 of together. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 2630 FMI 4 sets
Decision	
Does SPN 2630 FMI 4 set after DTC list is cleared?	Yes: Replace CACOT sensor. After repairs are complete, retest for SPN 2630 FMI 3.
	No: Go to Test 3.

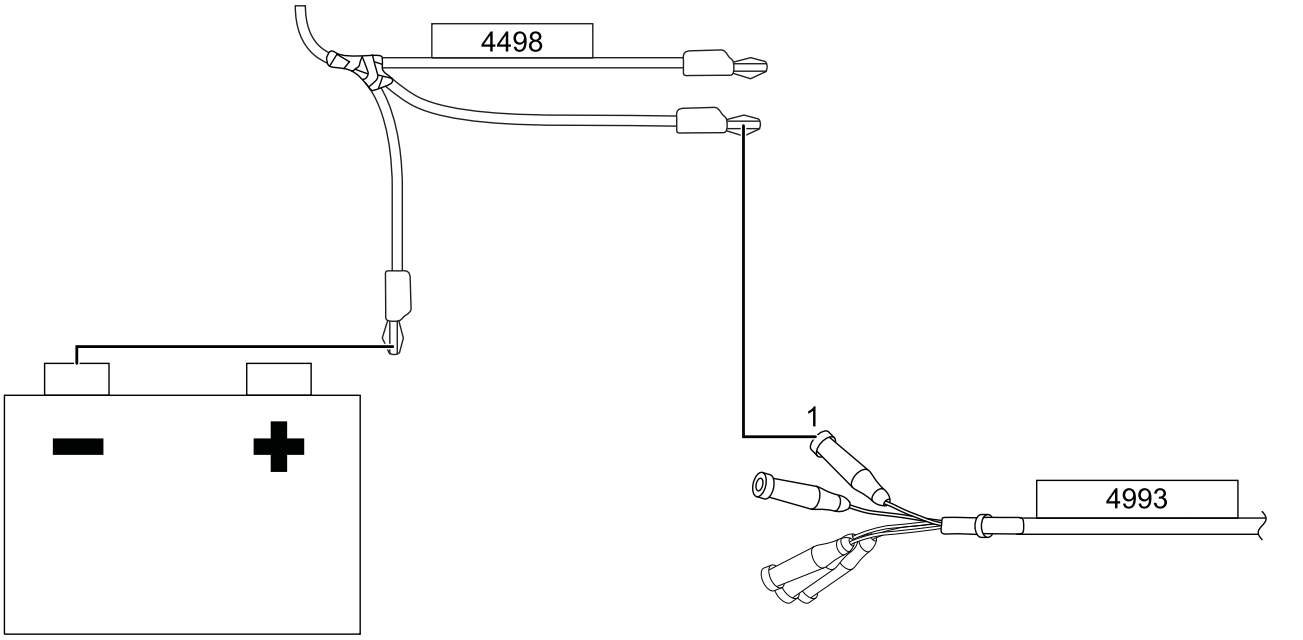


Figure 141 Test 3 CACOT Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Temperature (CACOT) sensor C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave CACOT disconnected. D. Using Breakout Harness ZTSE4498 short Breakout Harness ZTSE4993 pin-2 of to GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 2630 FMI 3 sets
Decision	
Does SPN 2630 FMI 3 set after DTC list is cleared?	Yes: Repair Open between CACOT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 2630 FMI 3.
	No: Repair Open between CACOT pin-2 and ECM pin E-65. After repairs are complete, retest for SPN 2630 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 2630 FMI 3 fault code diagnostics.

SPN 2630 FMI 4 - CACOT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Charge Air Cooler Outlet Temperature (CACOT) sensor signal is lower than expected.	CACOT sensor signal < 0.11 volts (> 311°F {155°C})	Key ON

Fault Overview

Fault Code sets when Engine Control Module (ECM) detects Charge Air Cooler Outlet Temperature (CACOT) signal is less than 0.11 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- CACOT circuit short to ground
- Failed CACOT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 2630 FMI 4. Is EST DTC list SPN 2630 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Charge Air Cooler Outlet Temperature (CACOT) sensor.	Decision
A. Key OFF. B. Disconnect CACOT electrical connector. C. Check CACOT sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent or broken pins; or broken connector housing. Are the CACOT sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2630 FMI 4.

Pin-Point Tests (SPN 2630 FMI 4)

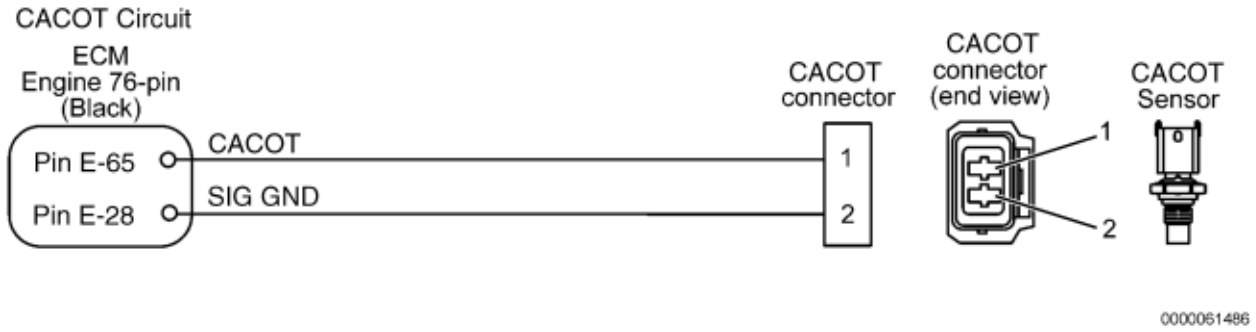


Figure 142 CACOT Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Charge Air Cooler Outlet Temperature (CACOT) sensor. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 2630 FMI 3 sets after DTC list is cleared
Decision	
Does SPN 2630 FMI 3 set after DTC list is cleared?	Yes: Replace CACOT sensor. After repairs are complete, retest for SPN 2630 FMI 4.
	No: Repair short to ground between CACOT pin-1 and Engine Control Module (ECM) pin E-65. After repairs are complete, retest for SPN 2630 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 2630 FMI 4 fault code diagnostics.

SPN 2630 FMI 16 - CACOT Undercooling

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

CCOSS Sensor (Crankcase Oil Separator Speed)

Overview of CCOSS Sensor Group

SPN	FMI	Description
4227	7	CC Oil Separator: Not spinning (page 459)

Overview

The CCOSS sensor sends the Engine Control Module (ECM) information about the speed of the crankcase oil separator internal components.

SPN 4227 FMI 7 - CC Oil Separator: Not spinning

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Measured Crankcase Breather speed is compared against threshold value. If speed is less than threshold fault will set.	Actual Breather Speed < Threshold defined by speed/engine coolant temperature based table (Table A131)	Engine speed shall be above or equal to an adjustable calibration threshold ≥ 800 rpm Engine Coolant Temperature 1 (ECT1) shall be above or equal to an adjustable calibration threshold ≥ 50°F (10°C) There is no engine coolant temperature out of range fault

Fault Overview

When measured crankcase breather speed is compared against threshold value as defined by speed / engine coolant temperature based table. If speed is less than threshold value, fault will set.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open or high resistance in CCOSS-H circuit
- Open or high resistance in CCOSS-L circuit
- Failed CCOSS sensor
- Failed CCOSS

Step 1	Verify operation of Crankcase Oil Separator Speed (CCOSS).	Decision
Perform Oil Breather Separator Test. Is Centrifugal or spinning sound heard inside CCOSS?		Yes: Go to Step 2. No: Replace CCOSS sensor. After repairs are complete, retest for SPN 4227 FMI 7.

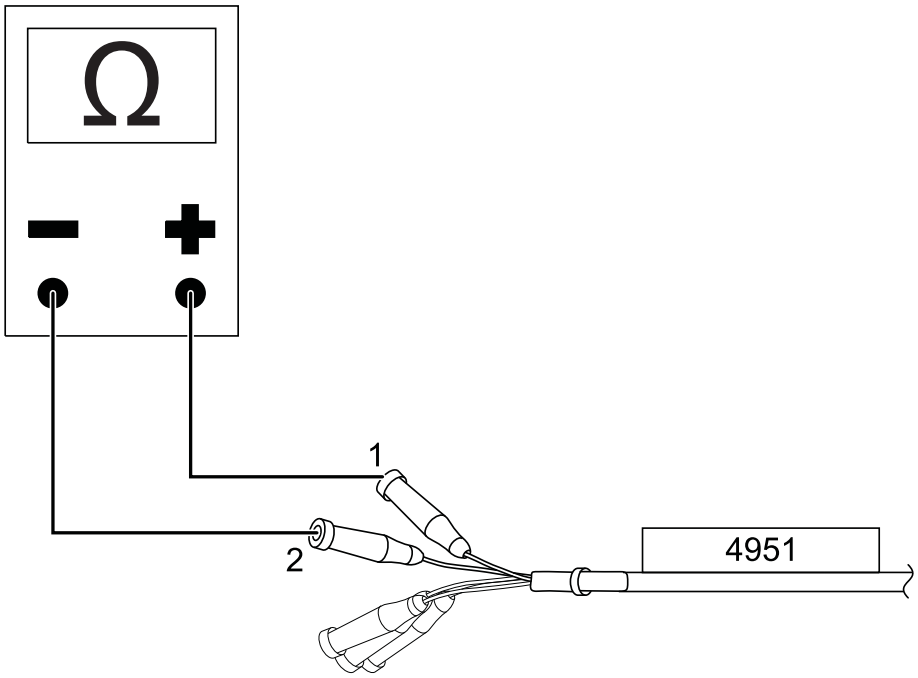
Step 2	Crankcase Oil Separator Speed (CCOSS) sensor connector inspection.	Decision
A. Key OFF. B. Disconnect CCOSS sensor. C. Check CCOSS sensor connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are CCOSS sensor connector, harness, and terminals clean and undamaged?		Yes: Perform pin point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4227 FMI 7.

Pin-Point Tests (SPN 4227 FMI 7)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4951.
- Digital Multimeter (DMM)

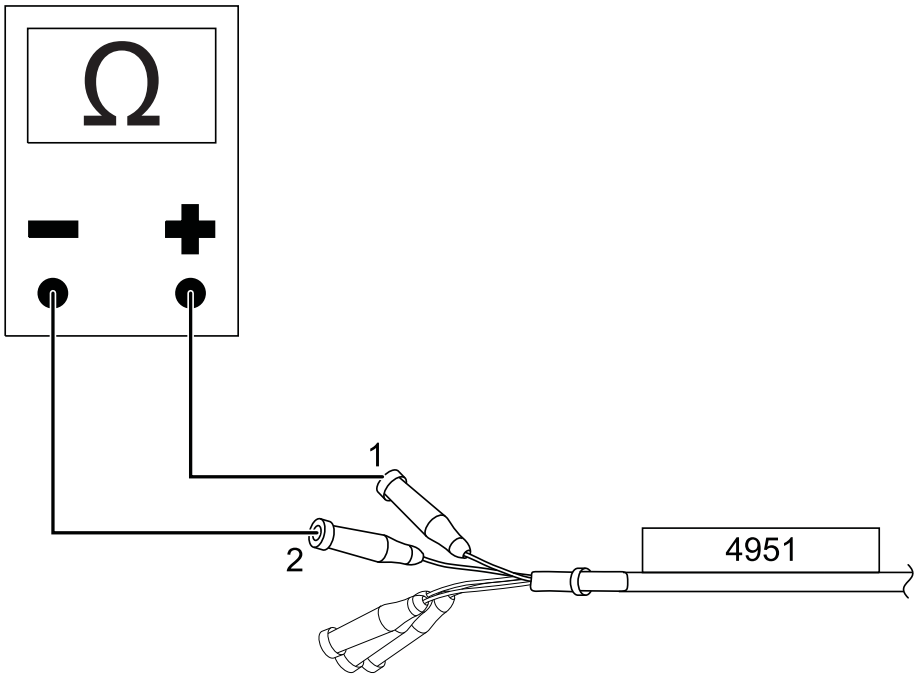


0000338461

Figure 144 Test 1: CCOSS Connector Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Crankcase Oil Separator Speed (CCOSS). C. Install Breakout Harness ZTSE4951 to CCOSS sensor harness and leave vehicle harness disconnected. D. Key ON

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4951 pin-2 and pin-1.	300 - 400 ohms
Decision	
Is resistance within 300 - 400 ohms?	Yes: Go to Test 2.
	No: Replace CCOSS sensor. After repairs are complete, retest for SPN 4227 FMI 7.



0000338461

Figure 145 Test 2: CCOSS Connector Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Crankcase Oil Separator Speed (CCOSS). C. Install Breakout Harness ZTSE4951 to vehicle harness and leave CCOSS sensor disconnected. D. Key ON

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4951 pin-2 and pin-1.	300 - 400 ohms
Decision	
Is resistance within 300 - 400 ohms?	Yes: Repair open or high resistance in CCOS-H circuit between CCOSS pin-1 and ECM pin E-34. After repairs are complete, retest for SPN 4227 FMI 7.
	No: Repair open or high resistance in CCOS-L circuit between CCOSS pin-2 and ECM pin E-17. After repairs are complete, retest for SPN 4227 FMI 7.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3556 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

CKP Sensor (Crankshaft Position)

Overview of CKP Sensor Group

SPN	FMI	Description
637	8	CKP signal noise (page 466)
637	10	CKP signal Inactive (page 468)

Overview

The Crankshaft Position (CKP) sensor provides the Engine Control Module (ECM) with a crankshaft speed and position signal. The ECM uses this signal with the Camshaft Position (CMP) signal to calculate engine speed and crankshaft position.

SPN 637 FMI 8 - CKP signal noise

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See iKNow Article IK1201042 for information on this fault code.

SPN 637 FMI 10 - CKP signal Inactive

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See iKNow Article IK1201042 for information on this fault code.

CMP Sensor (Camshaft Position)

Overview of CMP Sensor Group

SPN	FMI	Condition
636	2	CMP and CKP Synchronization Error (page 471)
636	7	CMP to CKP incorrect reference (page 473)

Overview

The Camshaft Position (CMP) sensor provides the Engine Control Module (ECM) with a camshaft speed and position signal. The ECM uses this signal with the Crankshaft Position (CKP) signal to monitor crankshaft and camshaft positions.

SPN 636 FMI 2 - CMP and CKP Synchronization Error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See iKNow Article IK1201042 for information on this fault code.

SPN 636 FMI 7 - CMP to CKP incorrect reference

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See iKNow Article IK1201042 for information on this fault code.

DCU Power (Doser Control Unit)

Overview of DCU Power Sensor Group

SPN	FMI	Description
609	19	ACM not detected on J1939 (page 476)
5109	3	DCU battery voltage above 17 volts (page 478)
5109	4	DCU battery voltage below 10 volts (page 480)
5109	19	DCU not detected on J1939 (page 488)

Overview

Doser Control Unit (DCU) controls Downstream Injection (DSI) System during a Diesel Particle Filter (DPF) regeneration. Engine Control Module (ECM) controls the monitoring and regeneration process in the aftertreatment system.

SPN 609 FMI 19 - ACM not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diagnostics of CAN communication link between the Engine Control Module and DCU	Message DCU_65315 is not received for > 3 seconds	Key ON
		CAN DCU diagnostics are not inhibited

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 5109 FMI 3 - DCU battery voltage above 17 volts

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Voltage supply to Hydrocarbon Doser Control Unit (DCU) higher than normal Voltage at output of Hydrocarbon DCU voltage divider higher than normal	Battery voltage > 17 Volts Battery Raw voltage measured after DCU voltage divider > 1 Volt	Key ON

Fault Overview

Fault sets when voltage supply to Hydrocarbon Doser Control Unit (DCU) is higher than normal; or voltage at output of Hydrocarbon DCU voltage divider is higher than normal

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Charging voltage excessive
- Incorrect battery pack wiring (series instead of parallel)

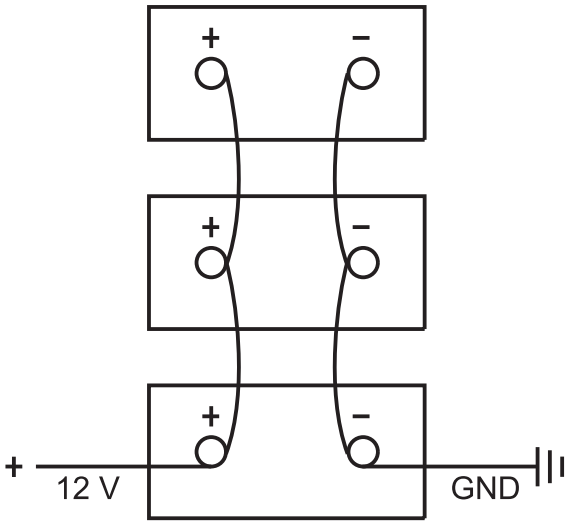


Figure 151 Approved Battery Cable Sequence

Step 1	Check for correct parallel battery pack wiring.	Decision
Check for correct parallel battery pack wiring. Positive battery cable(s) should be connected from positive battery terminal to positive battery terminal. Negative battery cable(s) should be connected from negative battery terminal to negative battery terminal. Is battery pack correctly assembled (wired in parallel and NOT in series)?		Yes: Replace alternator. After repairs are complete, retest for SPN 5109 FMI 3.
		No: Reassemble battery pack. After repairs are complete, retest for SPN 5109 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5109 FMI 3 fault code diagnostics.

SPN 5109 FMI 4 - DCU battery voltage below 10 volts

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Voltage supply to Hydrocarbon Doser Control Unit (DCU) lower than normal Voltage at output of Hydrocarbon DCU voltage divider lower than normal	Battery voltage < 10 Volts Battery Raw voltage measured after DCU voltage divider < 0.583 Volts	Key ON

Fault Overview

Fault set when voltage supply to Hydrocarbon Doser Control Unit (DCU) is lower than normal; or voltage at output of Hydrocarbon DCU voltage divider is lower than normal.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low battery or charging system voltage
- DCU PWR circuit high resistance
- GND circuit high resistance

WARNING: To prevent personal injury or death when working with batteries, always wear face or eye protection, have water supply available, ensure good ventilation, and be sure no flames or sparks are present.

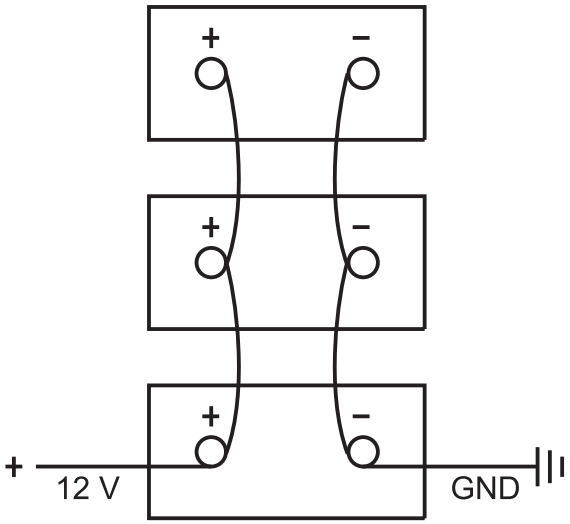


Figure 152 Approved Battery Cable Sequence

Step 1	Inspect battery connections and terminals.	Decision
A. Key OFF. B. Disconnect battery connections. C. Check battery connections and terminals for damage; wet or corroded terminals; loose, bent, or broken connections; or broken connector housing. **WARNING: To prevent personal injury or death, always disconnect main negative battery cable first. Always connect the main negative battery cable last.** Are battery connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5109 FMI 4.

Pin-Point Tests (SPN 5109 FMI 4)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM)

Test 1 Setup
A. Key OFF. B. Disconnect Battery negative connection. C. Disconnect Battery positive connection.

Test 1	Specification
Use DMM to measure voltage between Battery B+ and B-.	12 ± 0.5 volts
Decision	
Is voltage 12 ± 0.5 volts?	Yes: Go to Test 2.
	No: Charge batteries and check charging voltage. After repairs are complete, retest for SPN 5109 FMI 4.

Test 2 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin Connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-2 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between DCU Module pin-2 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Repair high resistance between DCU Module pin-2 and GND. After repairs are complete, retest for SPN 5109 FMI 4.

Test 3 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin Connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-1 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between DCU Module pin-1 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 4.
	No: Repair high resistance between DCU Module pin-1 and GND. After repairs are complete, retest for SPN 5109 FMI 4.

Test 4 Setup
A. Key OFF. B. Disconnect Under Hood PDM 15-Pin connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-1 and leave Under Hood PDM 15-Pin connector disconnected. D. Key ON.

Test 4	Specification
Use DMM to measure voltage between Under Hood PDM 15-Pin connector pin-1 and GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 5.
	No: Repair Open high resistance between Under Hood PDM 15-Pin connector pin-1 and PWR. After repairs are complete, retest for SPN 5109 FMI 4.

Test 5 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin Connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-7 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 5	Specification
Use DMM to measure voltage between DCU Module pin-7 and GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between DCU Module pin-6 and Under Hood PDM 15-Pin connector pin-1. After repairs are complete, retest for SPN 5109 FMI 4.
	No: Repair Open or high resistance between DCU Module pin-7 and Under Hood PDM 15-Pin connector pin-1. After repairs are complete, retest for SPN 5109 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5109 FMI 4 fault code diagnostics.

SPN 5109 FMI 19 - DCU not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diagnostics of CAN communication link between the Engine Control Module (ECM) and Doser Control Unit (DCU)	Message DCU_65315 is not received for > 0.1 seconds	Key ON

Fault Overview

Fault is set when diagnostics of CAN communication link between Engine Control Module (ECM) and Doser Control Unit (DCU) is not received for greater than 0.1 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5109 FMI 3 and 4 (DCU)			

Fault Facts

If ACM and DCU are both not detected on J1939, suspect a common circuit fault between them.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- CAN-H circuit short to GND
- CAN-L circuit short to GND
- CAN-H circuit short to PWR
- CAN-L circuit short to PWR
- CAN-H circuit Open
- CAN-L circuit Open
- CAN-H circuit short to CAN-L circuit

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 488). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5109 FMI 19.

Step 2	Check for active or pending fault codes.	Decision
Using EST) with ServiceMaxx™ software. Key ON, check DTC list for SPN 5109 FMI 19. Is EST DTC list SPN 5109 FMI 19 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 1	DCU Module 53-Pin and 86-Pin connector inspections.	Decision
A. Key OFF. B. Disconnect DCU Module connectors. C. Check DCU Module connections and terminals for damage; wet or corroded terminals; loose, bent, or broken connections; or broken connector housing. Are DCU Module connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5109 FMI 19.

Pin-Point Tests (SPN 5109 FMI 19)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- 42-Pin Engine to Chassis Interface Cable 00-00979-01
- 180-Pin Breakout Box 00-00956-08
- Digital Multimeter (DMM)

Test 1 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-14 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between DCU Module 53-Pin connector pin-14 and GND.	2.5 ± 0.5 volts.
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 2.
	No: Repair CAN-H short to GND. After repairs are complete, retest for SPN 5109 FMI 19.

Test 2 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-14 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between DCU Module 53-Pin connector pin-14 and GND.	2.5 ± 0.5 volts.
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 3.
	No: Repair CAN-H short to PWR. After repairs are complete, retest for SPN 5109 FMI 19.

Test 3 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-15 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between DCU Module 53-Pin connector pin-15 and GND.	2.5 ± 0.5 volts.
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 4.
	No: Repair CAN-L short to GND. After repairs are complete, retest for SPN 5109 FMI 19.

Test 4 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin Connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-15 and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 4	Specification
Use DMM to measure voltage between DCU Module pin-15 and GND.	2.5 ± 0.5 volts.
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 5.
	No: Repair CAN-L short to PWR. After repairs are complete, retest for SPN 5109 FMI 19.

Test 5 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin Connector. C. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-15 and pin-14, and leave DCU Module 53-Pin connector disconnected. D. Key ON.

Test 5	Specification
Use DMM to measure resistance between DCU Module pin-14 and pin-15.	Greater than 50 ohms.
Decision	
Is resistance greater than 50 ohms?	Yes: Go to Test 6.
	No: Repair Short between CAN-H and CAN-L. After repairs are complete, retest for SPN 5109 FMI 19.

Test 6 Setup
A. Key OFF. B. Disconnect DCU Module 53-Pin connector. C. Disconnect 42-Pin IP / Engine connector. D. Connect applicable terminal test pin from Terminal Test Kit ZTSE4435C to vehicle harness pin-14 and leave DCU Module 53-Pin connector disconnected. E. Connect Breakout Harness 00-00979-01 to vehicle harness and leave 42-Pin IP / Engine connector disconnected. F. Key ON.

Test 6	Specification
Use DMM to measure resistance between DCU Module pin-14 and Breakout Harness 00-00979-01 pin-11.	Greater than 5 ohms.
Decision	
Is resistance greater than 5 ohms?	Yes: Repair Open or high resistance between DCU pin-14 and ECM pin C-61. After repairs are complete, retest for SPN 5109 FMI 19.
	No: Repair Open or high resistance between DCU pin-15 and ECM pin C-62. After repairs are complete, retest for SPN 5109 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5109 FMI 19 fault code diagnostics.

DEF (Diesel Exhaust Fluid)

Overview of DEF Sensor Group

SPN	FMI	Description
520668	31	Controller Adaptation Outer Limits Reached (Low Reductant Delivery) (page 498)
520669	31	Controller Adaptation Inner Limits Reached (Low Reductant Delivery) (page 503)

Overview

Diesel Exhaust Fluid (DEF) is nontoxic, nonflammable, colorless liquid that delivers ammonia to Selective Catalyst Reduction (SCR) system.

SPN 520668 FMI 31 - Controller Adaptation Outer Limits Reached (Low Reductant Delivery)

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxide Outlet Concentration (NOx Out) sensor is requesting more Diesel Exhaust Fluid (DEF) than expected.	{[Percent of time (Estimated NOx reduction levels) / (Measured NOx reduction levels) < 60 ppm] / [Percent of time all enable conditions are active]} > 100%	Engine protection Not active Barometric Absolute Pressure (BARO) density ≥ 0 kg/m3 Ambient Air Temperature (AAT) ≥ 19.4°F (-7°C) BARO ≥ 10.9 psi (75 kpa) gauge Exhaust Gas mass flow rate ≥ 20 g/sec Diesel Particulate Filter Outlet Temperature (DPFOT) ≤ 1292°F (700°C) DEF pump pressure control is completed AND DEF supply pressure is within the range of 116 - 145 psi (800 - 1,000 kPa) gauge for > 3 seconds NH3 sensor status and signal valid Ammonia Storage Timer ≥ 1400 seconds Exhaust flow rate ≥ 130 g/sec for 20 seconds Injection command ≥ 0.2 g/sec for 20 seconds The following fault codes must be inactive: SPN 3226 FMI 4, 9, 10, 13, 20 (NOx Out); SPN 3228 FMI 2 (NOx Out); SPN 3242 FMI 2, 3, 4 (DPFIT); SPN 3246 FMI 2, 3, 4 (DPFOT); SPN 3361 FMI 2 (DEF Supply Pump); SPN 4360 FMI 2, 3, 4 (SCRIT); SPN 4363 FMI 2, 3, 4 (SCRIT); SPN 4364 FMI 18 (AFT); SPN 4377 FMI 2, 4, 12, 13 (NH3); SPN 4380 FMI 2 (NH3); SPN 4765 FMI 2, 3, 4 (DOCIT); SPN 4794 FMI 31 (AFT); SPN 5031 FMI 10 (AFT); SPN 5742 FMI 3, 4, 11 (DOC/DPF Temperature Sensor Module); SPN 5743 FMI 3, 4, 11 (SCR Temperature Sensor Module)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxide Outlet Concentration (NOx Out) sensor is requesting more Diesel Exhaust Fluid (DEF) than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• N 3216 (NOx In)	• SPN 3218 (NOx In)	• SPN 3226 (NOx Out)	• SPN 3228 (NOx Out)
• SPN 3361 FMI 2, 3, and 4 (DEF: SP)	• SPN 3362 FMI 31 (DEF: SP)	• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 4334 FMI 2, 16 and 18 (DEF: AP)
• SPN 4340 FMI 3 and 5 (DEF: L1HC)	• SPN 4342 FMI 3 and 5 (DEF: L2HC)	• SPN 4344 FMI 3 and 5 (DEF: L3HC)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)
• SPN 4363 FMI 2, 3, and 4 (SCROT)	• SPN 4377 (NH3)	• SPN 4380 (NH3)	• SPN 4382 (NH3)
• SPN 5394 FMI 5 and 7 (DEF: DU)	• SPN 5743 (SCR temp sensor module)	• SPN 520669 (AFT system)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust system leak(s)
- DEF tank, supply module, or doser valve line or connection loose, leaking, damaged, or restricted
- Contaminated or degraded DEF
- Failed or restricted DEF Dosing Unit (DEF: DU)
- Restricted DEF supply module filter
- DEF crystallization or deposits in decomposition tube
- Failed Selective Catalyst Reduction (SCR) catalyst

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 499). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 520668 FMI 31.

Step 2	Inspect exhaust system.	Decision
Inspect exhaust system for leaks and physical damage. Is exhaust system free of leaks and physical damage?		Yes: Go to Step 3. No: Repair leaks or physical damage. After repairs are complete, retest for SPN 520668 FMI 31.

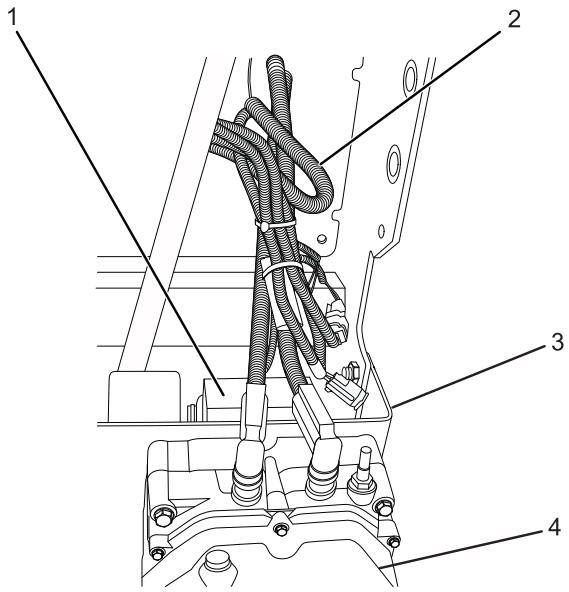


Figure 153 DEF Supply Module Location (Typical)

1. PDM
2. DEF lines
3. DEF tank bracket
4. DEF supply module

Step 3	Inspect connections at DEF tank, DEF supply module, and DEF Doser Unit (DEF: DU) lines.	Decision
A. Key OFF. B. Disconnect DEF: DU sensor module connector. C. Check DEF tank, DEF supply module, and DEF: DU lines and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF tank, DEF supply module, and DEF: DU lines and connections in good condition and unrestricted?		Yes: Go to Step 4 No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 520668 FMI 31.

Step 4	Check DEF quality.	Decision
A. Key OFF. B. Obtain a sample of DEF. C. Visually inspect for contamination, and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 32.5 ± 1.5% and not contaminated?		Yes: Go to Step 5 No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 520668 FMI 31.

Step 5	Verify correct DEF: DU operation.	Decision
A. Key OFF. B. Using EST, perform KOEO DEF Supply Pump Override Test (page 2165). Is DEF: DU operating correctly?		Yes: Go to Step 6. No: Replace DEF supply module filter and clean DEF supply module using 18-200-01. Repeat step 8. If DEF: DU still does not operate correctly, replace DEF: DU. After repairs are complete, retest for SPN 520668 FMI 31.

Step 6	Check decomposition tube for crystallization.	Decision
A. Key OFF. B. Disconnect decomposition tube from exhaust system. C. Visually inspect decomposition tube for DEF crystallization. Is decomposition tube free of DEF crystallization?		Yes: Remove and inspect SCR catalyst. Replace SCR catalyst if damage or plugging is found. After repairs are complete, retest for SPN 520668 FMI 31. No: Remove DEF crystallization from decomposition tube. After repairs are complete, retest for SPN 520668 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if 520668 FMI 31 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 520669 FMI 31 - Controller Adaptation Inner Limits Reached (Low Reductant Delivery)

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxide Outlet Concentration (NOx Out) sensor is requesting more Diesel Exhaust Fluid (DEF) than expected.	(Percent of time Inner Loop is used up) / (Percent of time all Enable Conditions are active) > 98% Inner Loop used up = ([NH3 sensor is requesting high dosing for the Selective Catalyst Reduction (SCR) AND (NH3 sensor ≤ 1.5 ppm) OR (SCR Intake Temperature (SCRIT) ≤ 518°F [270°C]) OR (Estimate SCR brick temperature ≤ 482°C [250°C])] AND (Ammonia adjusted reference - Mid-bed Ammonia concentration) > 34.7°F/sec (1.5°C/sec)	Engine protection active Barometric Absolute Pressure (BARO) density ≥ 0 kg/m3 Ambient Air Temperature (AAT) ≥ 19.4°F (-7°C) BARO Pressure ≥ 10.9 psi (75 kPa) gauge Exhaust Gas mass flow rate ≥ 20 g/sec Diesel Particulate Filter Outlet Temperature (DPFOT) ≤ 1292°F (700°C) DEF pump pressure control is completed AND DEF supply pressure is within the range of 116 - 145 psi (800 - 1,000 kPa) gauge for > 3 seconds NH3 sensor status and signal valid Ammonia Storage Timer ≥ 1400 seconds Exhaust flow rate ≥ 130 g / sec for 20 seconds Injection command ≥ 0.2 g / sec for 20 seconds Inactive: SPN 3226 FMI 4, 10, 13, 20 (NOx Out); SPN 3228 FMI 2 (NOx Out); SPN 3242 FMI 2, 3, 4 (DPFIT); SPN 3246 FMI 2, 3, 4 (DPFOT); SPN 3361 FMI 2 (DEF Supply Pump); SPN 4360 FMI 2, 3, 4 (SCRIT); SPN 4363 FMI 2, 3, 4 (SCRIT); SPN 4364 FMI 18 (AFT); SPN 4377 FMI 2, 4, 12, 13 (NH3); SPN 4380 FMI 2 (NH3); SPN 4765 FMI 2, 3, 4 (DOCIT); SPN 4794 FMI 31 (AFT); SPN 5031 FMI 10 (AFT); SPN 5742 FMI 3, 4, 11 (DOC/DPF Temperature Sensor Module); SPN 5743 FMI 3, 4, 11 (SCR Temperature Sensor Module)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Aftertreatment Ammonia (NH3) sensor is requesting more Diesel Exhaust Fluid (DEF) than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3216 (NOx In)	• SPN 3218 (NOx In)	• SPN 3226 (NOx Out)	• SPN 3228 (NOx Out)
• SPN 3361 FMI 2, 3, and 4 (DEF: SP)	• SPN 3362 FMI 31 (DEF: SP)	• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 4334 FMI 2, 16 and 18 (DEF: AP)
• SPN 4340 FMI 3 and 5 (DEF: L1HC)	• SPN 4342 FMI 3 and 5 (DEF: L2HC)	• SPN 4344 FMI 3 and 5 (DEF: L3HC)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)
• SPN 4363 FMI 2, 3, and 4 (SCROT)	• SPN 4377 (NH3)	• SPN 4380 (NH3)	• SPN 4382 (NH3)
• SPN 5394 FMI 5 and 7 (DEF: DU)	• SPN 5743 (SCR Temperature Sensor Module)	• SPN 520669 (AFT System)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust system leak(s)
- DEF tank, supply module, or doser valve line or connection loose, leaking, damaged, or restricted
- Contaminated or degraded DEF
- Failed or restricted Diesel Exhaust Fluid Dosing Unit (DEF: DU)
- Restricted DEF supply module filter
- DEF crystallization or deposits in decomposition tube
- Failed Selective Catalyst Reduction (SCR) catalyst

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 504). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 520669 FMI 31.

Step 2	Inspect exhaust system.	Decision
Inspect exhaust system for leaks and physical damage. Is exhaust system free of leaks and physical damage?		Yes: Go to Step 3. No: Repair leaks or physical damage. After repairs are complete, retest for SPN 520669 FMI 31.

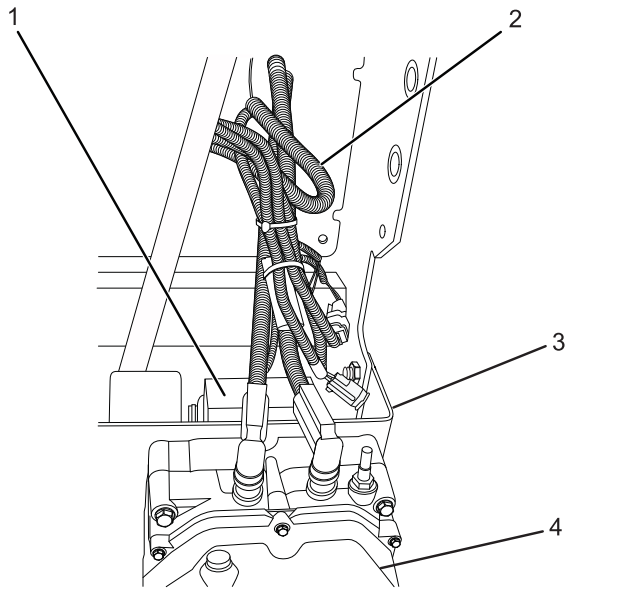


Figure 154 DEF Supply Module Location Typical

1. PDM
2. DEF lines
3. DEF tank bracket
4. DEF supply module

Step 3	Inspect connections at DEF tank, DEF supply module, and DEF: DU lines.	Decision
A. Key OFF. B. Disconnect DEF: DU sensor module connector. C. Check DEF tank, DEF supply module, and DEF: DU lines and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF tank, DEF supply module, and DEF: DU lines and connections in good condition and unrestricted?		Yes: Go to Step 4. No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 520669 FMI 31.

Step 4	Check DEF quality.	Decision
A. Key OFF. B. Obtain a sample of DEF. C. Visually inspect for contamination, and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 32.5% ± 1.5% and not contaminated?		Yes: Go to Step 5. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 520669 FMI 31.

Step 5	Verify correct DEF: DU operation.	Decision
A. Key OFF. B. Using EST, perform KOEO DEF Pump Override Test (page 2165). Is DEF: DU operating correctly?		Yes: Go to Step 6. No: Replace DEF supply module filter and clean DEF supply module using 18-200-01. Repeat step 8. If DEF: DU still does not operate correctly, replace DEF: DU. After repairs are complete, retest for SPN 5206689 FMI 31.

Step 6	Check decomposition tube for crystallization.	Decision
A. Key OFF. B. Disconnect decomposition tube from exhaust system. C. Visually inspect decomposition tube for DEF crystallization. Is decomposition tube free of DEF crystallization?		Yes: Remove and inspect SCR catalyst. Replace SCR catalyst if damage or plugging is found. After repairs are complete, retest for SPN 520668 FMI 31. No: Remove DEF crystallization from decomposition tube. After repairs are complete, retest for SPN 520669 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if 520669 FMI 31 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

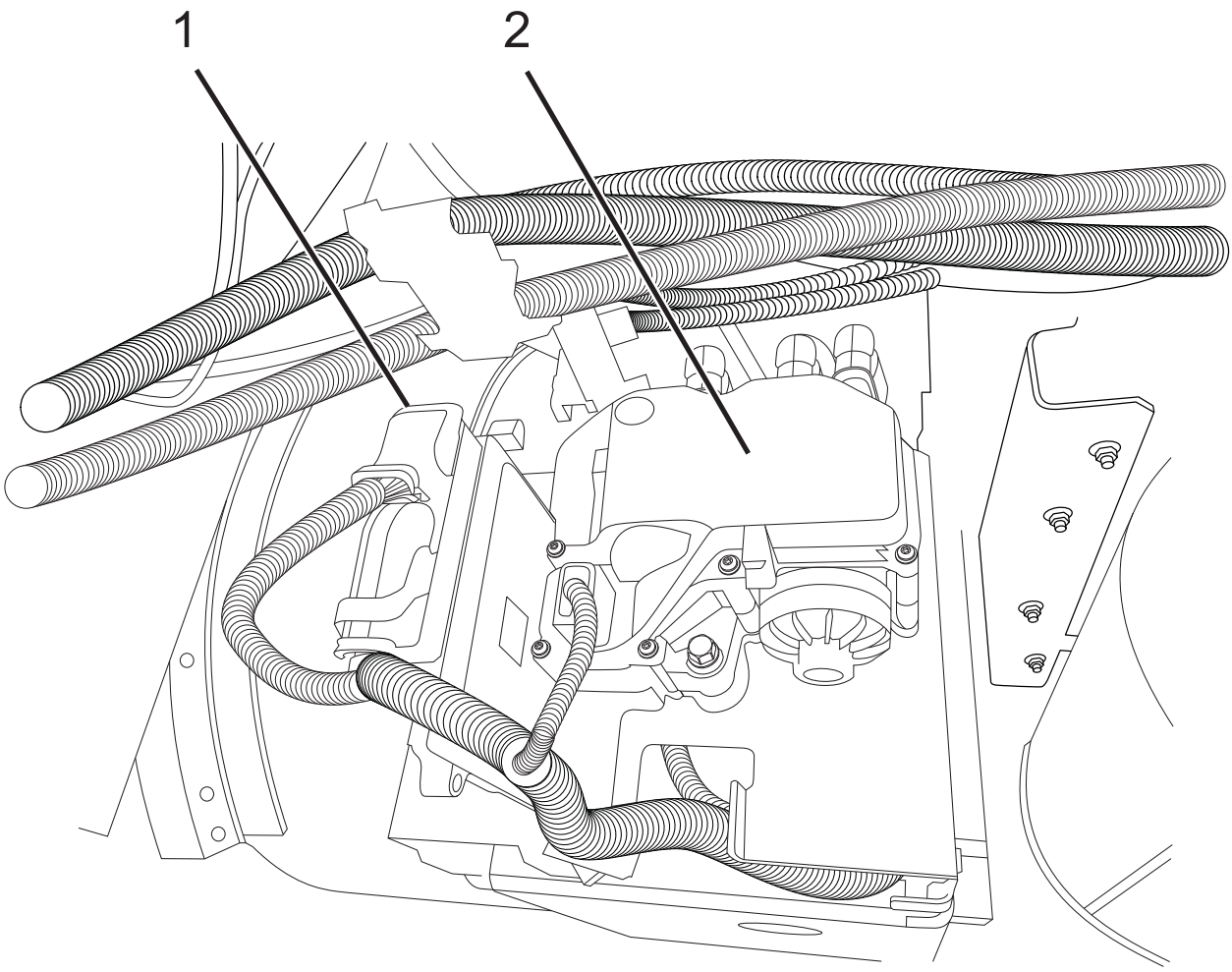
DEF: SMH (Diesel Exhaust Fluid Supply Module Heater)

Overview of DEF: SMH Sensor Group

SPN	FMI	Description
5745	3	DEF Supply Module Heater Out of Range HIGH (page 510)
5745	4	DEF Supply Module Heater Out of Range LOW (page 516)
5745	18	DEF Supply Module Heater below Warning Temperature (page 533)
5798	2	DEF Supply Module Heater Temperature erratic, intermittent or incorrect (page 540)
5798	10	DEF Supply Module Heater Temperature abnormal rate of change (page 547)

Overview

Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) is controlled by Aftertreatment Control Module (ACM). When ACM commands DEF: SMH On, it heats DEF supply module to prevent freezing. Diagnostics are run when DEF Supply Module HTR Relay (DEF: SMH Relay) is Off. DEF: SMH is not serviceable individually, and is part of DEF supply module.



0000054368

Figure 155 DEF Supply Module Location

1. ACM
2. DEF Supply Module

SPN 5745 FMI 3 - DEF Dosing Unit Heater Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) supply module temperature too high when heater is off.	DEF supply module temperature rises > 54°F (12°C) within a predetermined time	DEF: SMH Relay command is OFF Initial DEF: SMH temperature at Key ON ≤ 104°F (40°C) Inactive: SPN 3361 FMI 2 (DEF: SP); SPN 5746 FMI 3, 4 (DEF: SMH Relay); SPN 5798 FMI 2 (DEF: SMH Temp)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) is active when not commanded ON. DEF injection into aftertreatment system will be disabled, and engine torque will be reduced if engine is operated for an extended period of time with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected.

Associated Faults

• SPN 3361 (DEF: SP)	• SPN 5746 FMI 3, 4 (DEF: SMH Relay)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SMH power circuit short to PWR
- Failed DEF: SMH Relay
- Failed DEF supply module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 510). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 3.

Step 2	Inspect connections at DEF supply module connector.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 3.

Pin-Point Tests (SPN 5745 FMI 3)

See latest version of Navistar® N13 Engine and Aftertreatment Wiring Schematic Form 0000002203 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

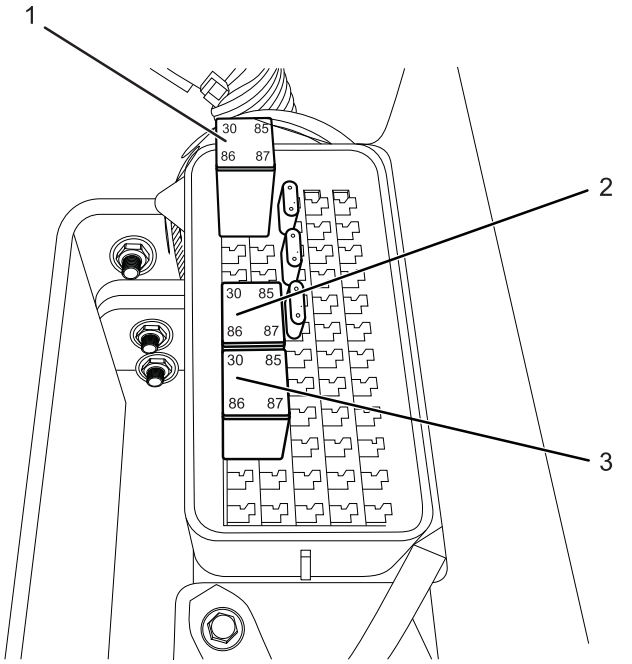
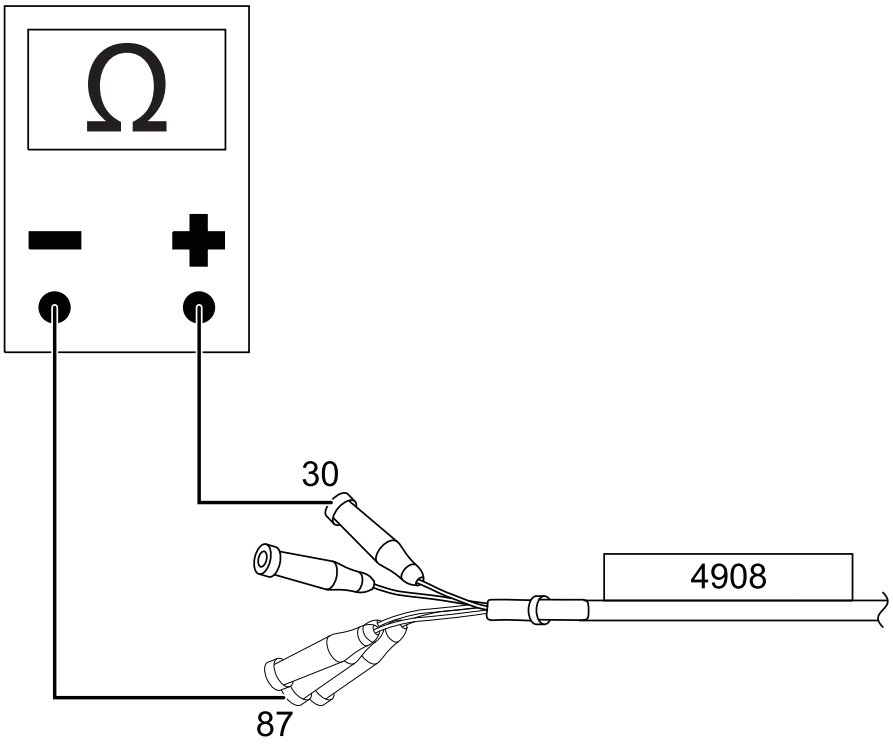


Figure 156 Power Distribution Module (PDM) Fuses and Relays (typical)

1. DEF line heater relay
2. DEF: SMH Relay
3. Switched ignition relay



0000307678

Figure 157 Test 1 DEF: SMH Relay Resistance Check

Test 1 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install DEF: SMH Relay into Breakout Harness ZTSE4098.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-30 and pin-87.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Replace DEF: SMH Relay. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 3.

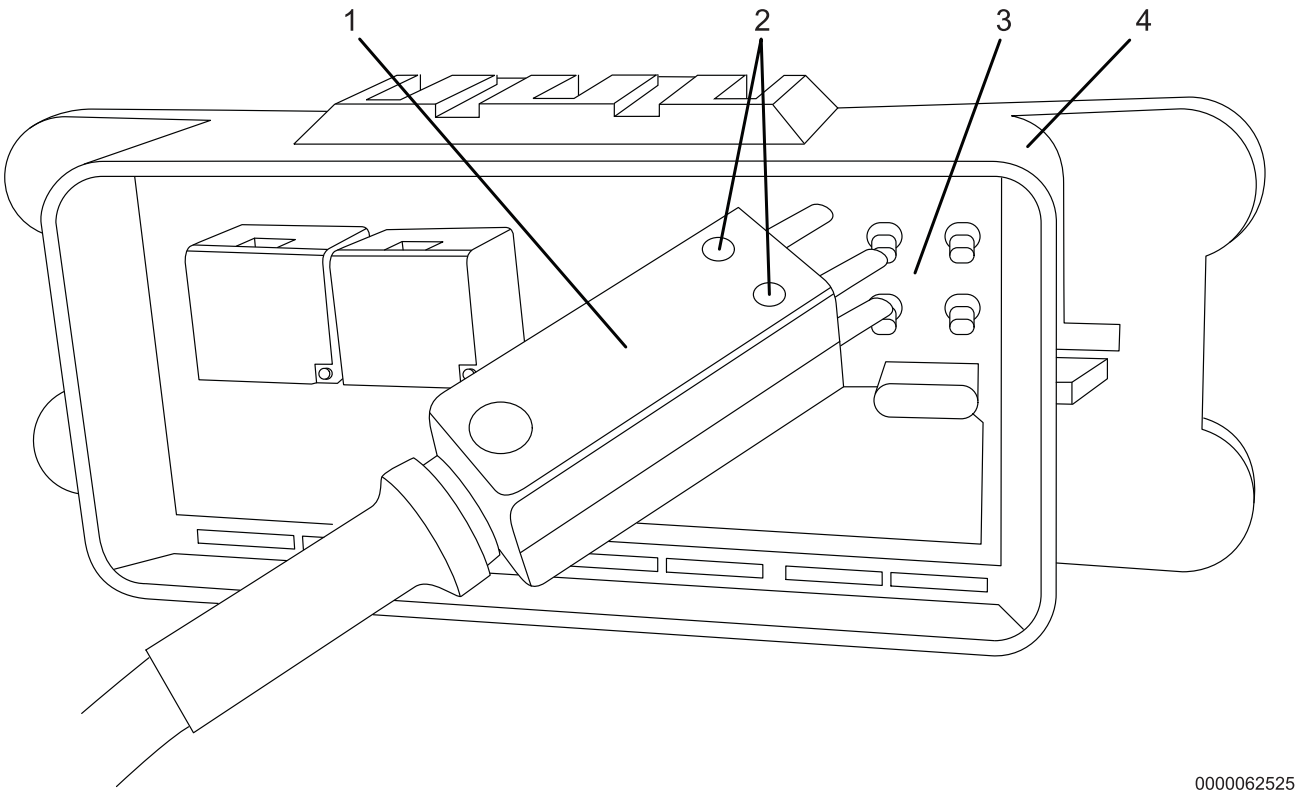


Figure 158 Installation of Breakout Harness ZTSE4908

1. Breakout Harness ZTSE4908
2. Installation dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

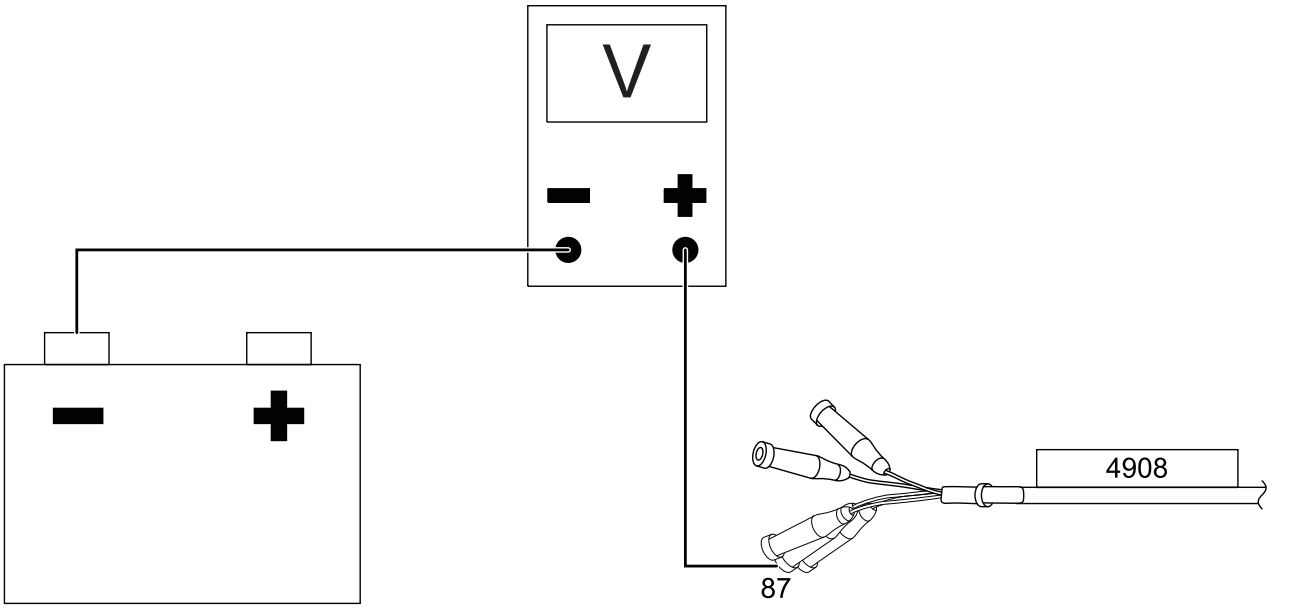


Figure 159 Test 2 DEF: SMH Relay Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install Breakout Harness ZTSE4908 into PDM, and leave relay disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-87 and known good ground.	Less than 0.5 volts.
Decision	
Is voltage less than 0.5 volts?	Yes: Replace DEF supply module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 3.
	No: Repair short to PWR between DEF: SMH Relay pin-87 and DEF supply module connector pin-5. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5745 FMI 3 fault code diagnostics.

SPN 5745 FMI 4 - DEF Supply Module Heater Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) supply module temperature is too low when heater is on.	DEF supply module temperature does not rise by at least 41°F (5°C) within predetermined time when heater is ON	Initial temperature at Key ON < 25°F (-4°C) DEF supply module heater is ON The diagnostic has not previously completed during this key cycle Inactive: SPN 3361 FMI 2 (DEF: SP); SPN 5746 FMI 3, 4 (DEF: SMH Relay); SPN 5798 FMI 2 (DEF: SMH Temp)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid (DEF) supply module temperature is too low when heater is in ON position. DEF injection into aftertreatment system will be disabled, and engine torque will be reduced if engine is operated for an extended period of time with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected.

Associated Faults

• SPN 3361 (DEF: SP)	• SPN 4337 FMI 2 (DEF: SP Temp)	• SPN 5746 FMI 3, 4 (DEF: SMH Relay)	• SPN 5798 FMI 2 (DEF: SMH Temp)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF Supply Module Heater (DEF: SMH) power circuit Open or high resistance
- DEF: SMH power circuit short to GND
- DEF: SMH groung circuit Open or high resistance
- Blown fuse or open power circuit to DEF: SMR Relay
- Failed DEF: Supply Module Relay (DEF: SM Relay)
- Failed DEF supply module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 516). Is EST DTD free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

Step 2	Check for active faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 5745 FMI 4. Is SPN 5745 FMI 4 an active fault?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module, connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

Pin-Point Tests (SPN 5745 FMI 4)

See latest version of Navistar® N9 and N10Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-909-01
- Breakout Harness ZTSE4908
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)

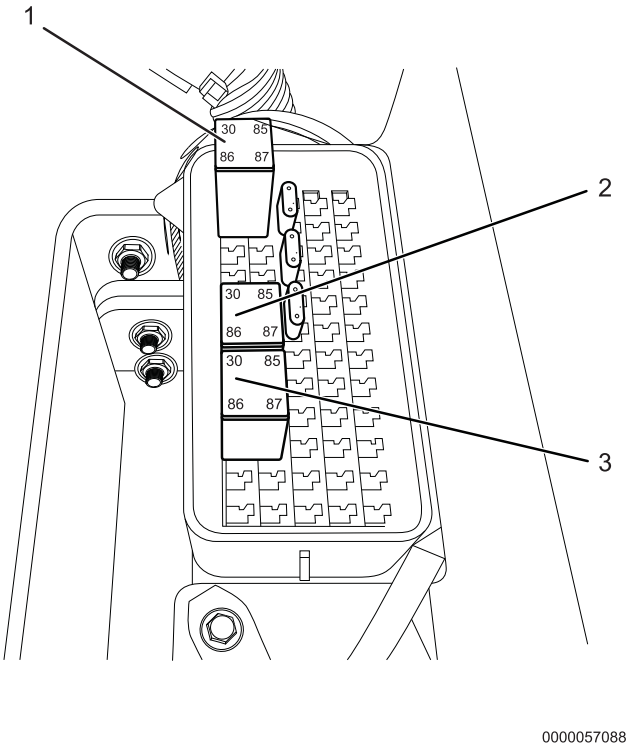


Figure 160 PDM Fuses and Relays (Typical)

1. DEF line heater relay
2. DEF: SMH Relay
3. Switched ignition relay

Test 1 Setup
A. Key OFF. B. Remove DEF: SMH Relay 10-amp fuse.

Test 1	Specification
Use DMM to measure resistance of DEF: SMH Relay 10-amp fuse.	Less than 1 ohm
Decision	
Is resistance of DEF: SMH Relay fuse less than 1 ohm?	Yes: Reinstall DEF: SMH Relay 10-amp fuse. Go to Test 5.
	No: Go to Test 2.

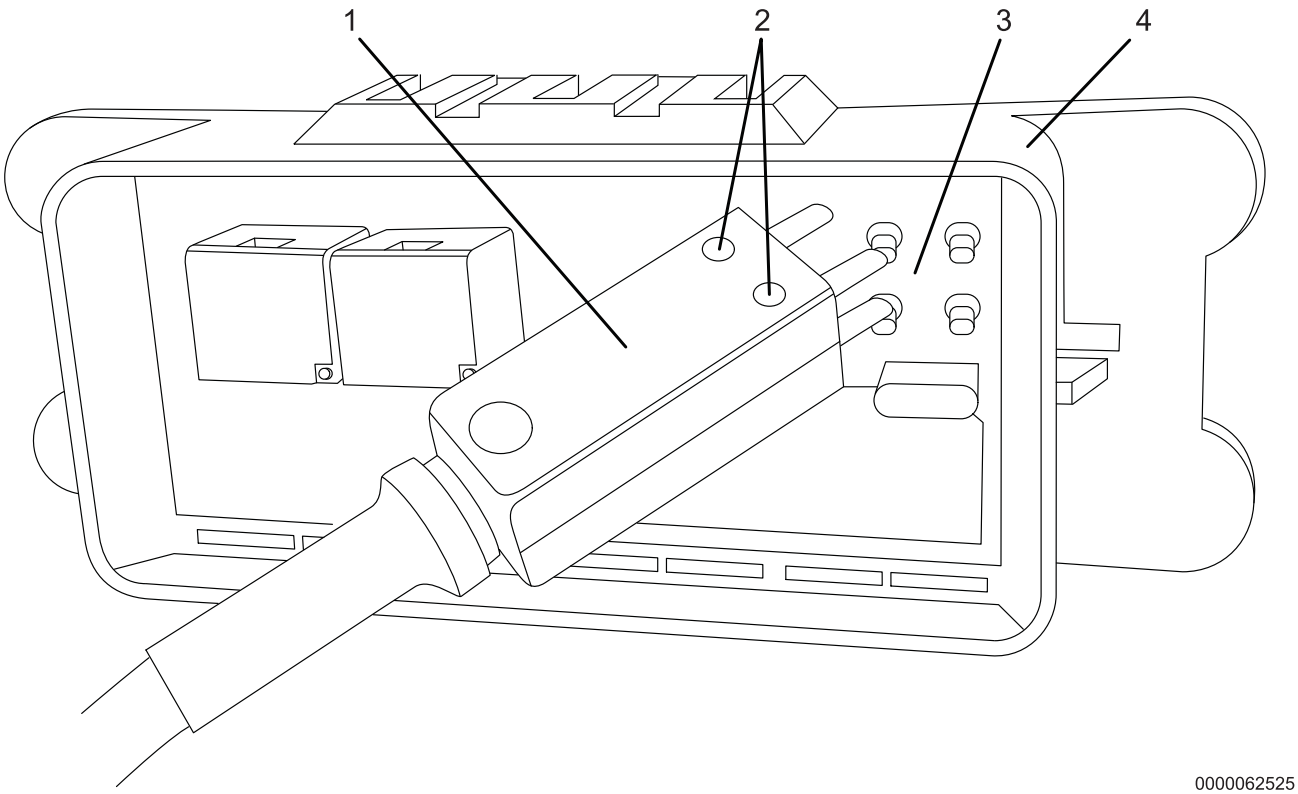


Figure 161 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

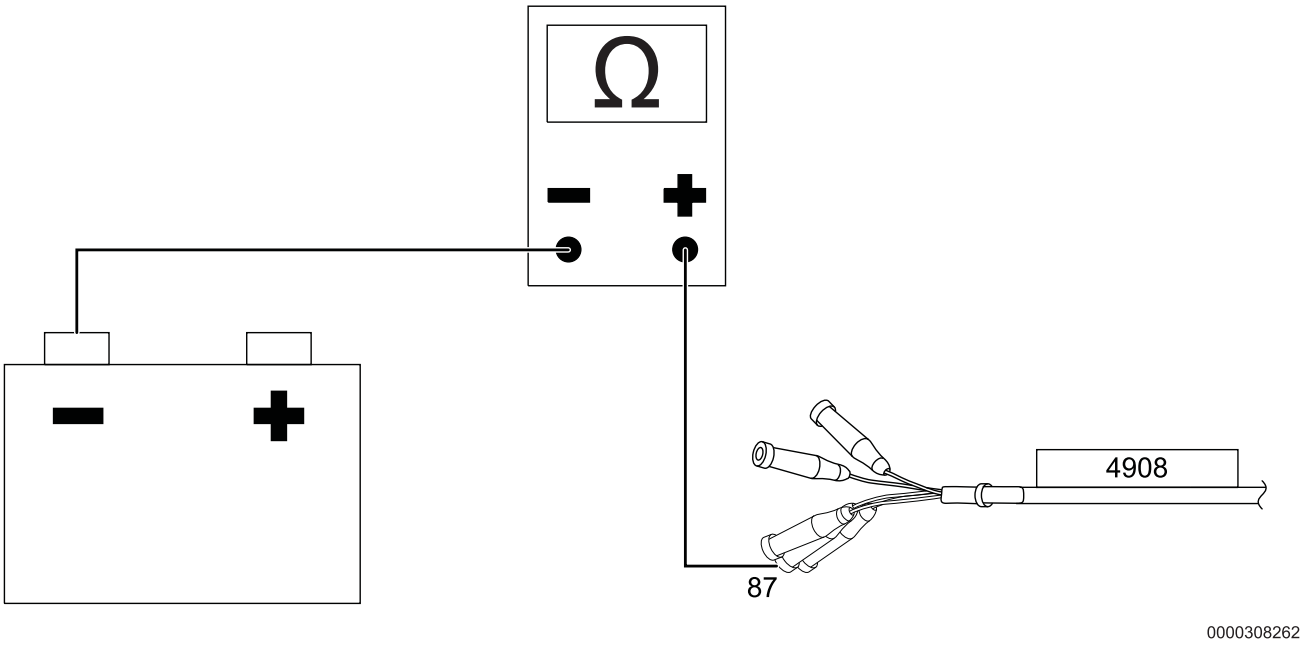


Figure 162 Test 2 DEF: SMH Relay Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install Breakout Harness ZTSE4908 into PDM and leave DEF: SMH Relay disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-87 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Repair short to GND between DEF supply module pin-5 and DEF: SMH Relay pin-87. Replace fuse. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

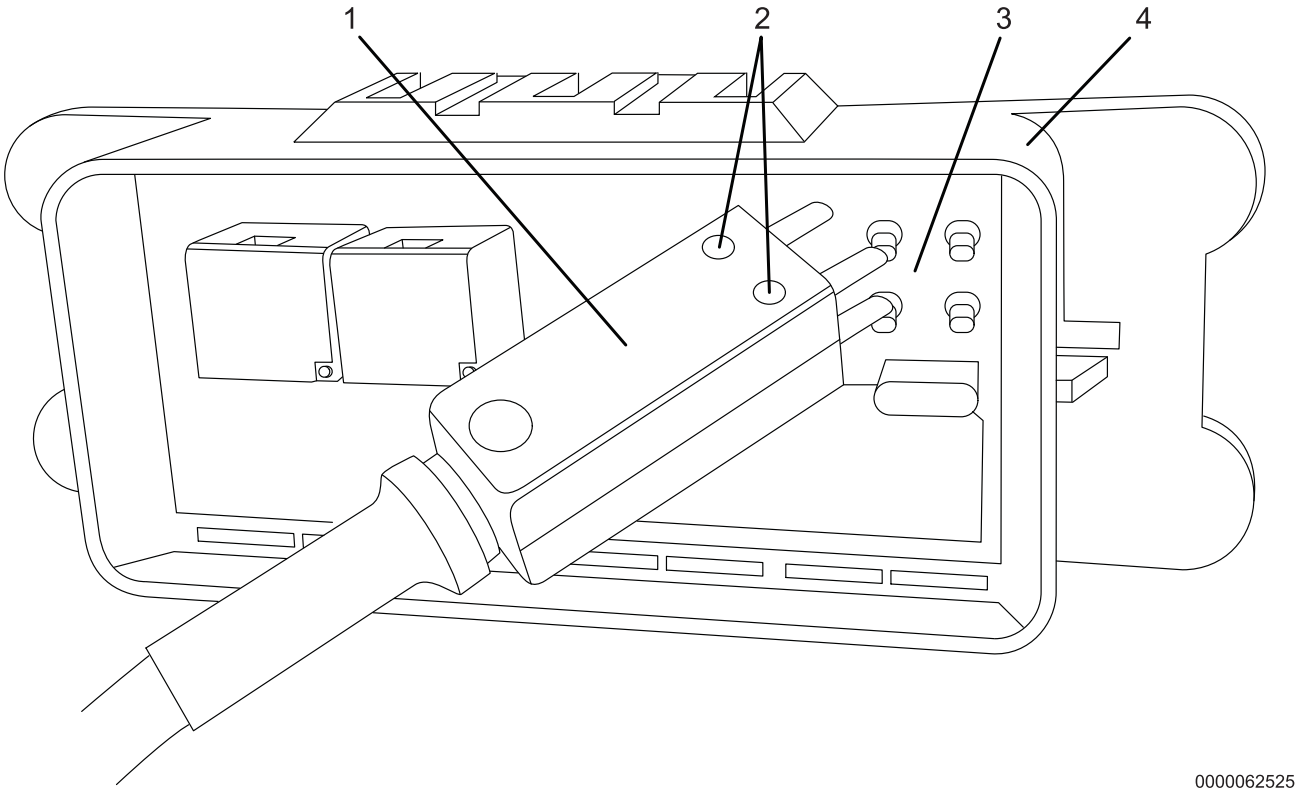


Figure 163 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

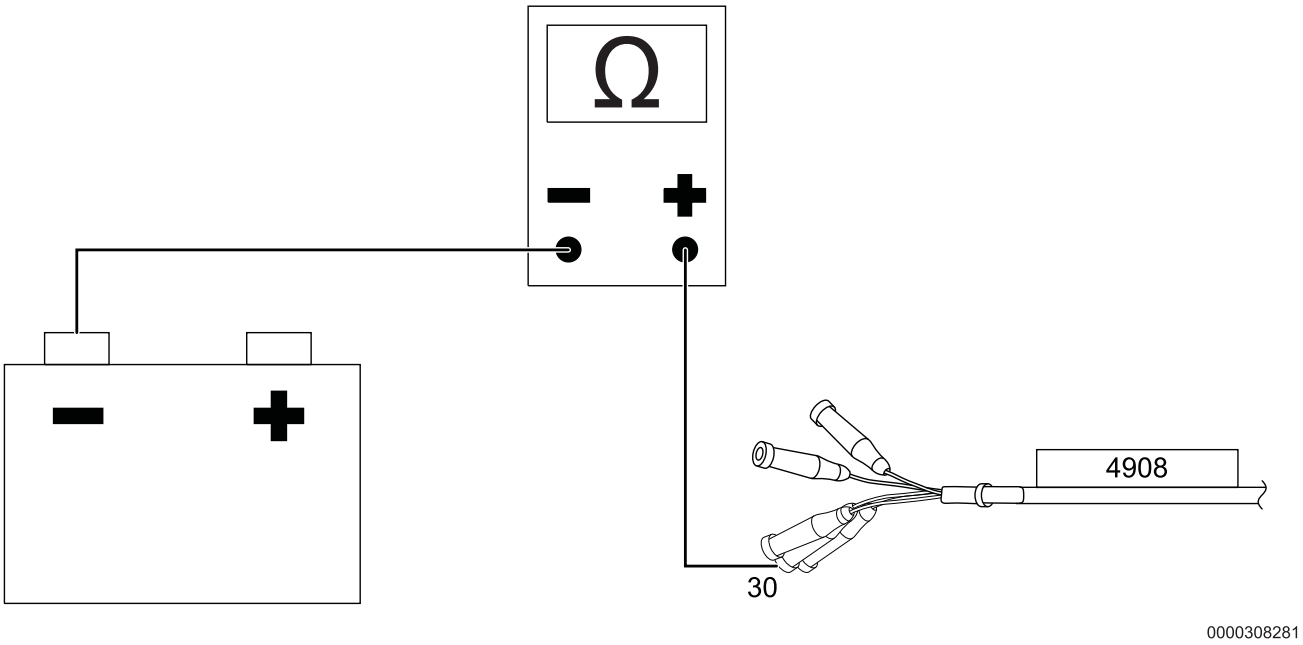
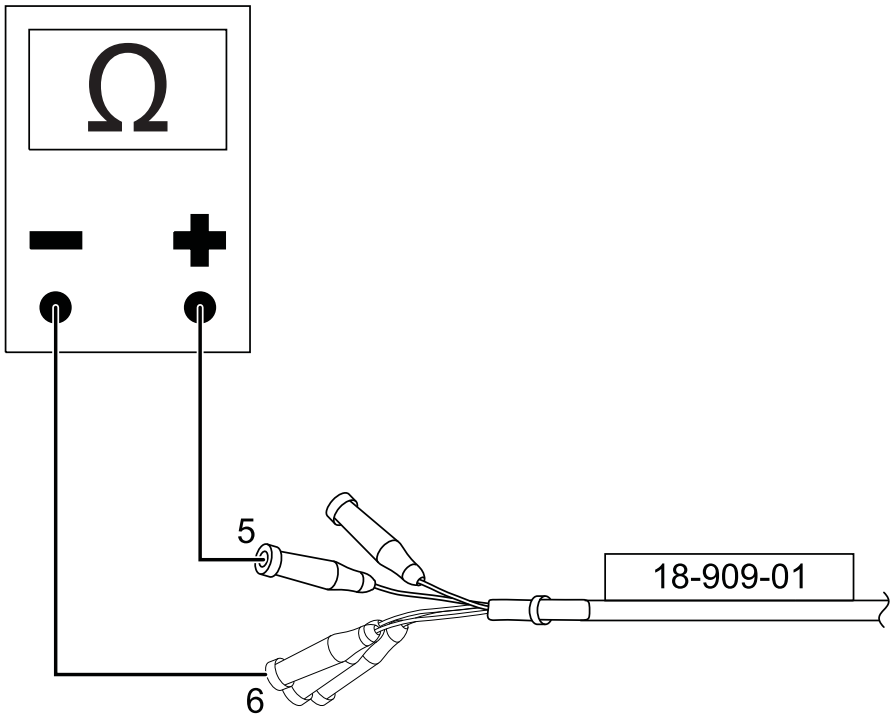


Figure 164 Test 3 DEF: SMH Relay Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install Breakout Harness ZTSE4908 into PDM and leave DEF: SMH Relay disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-30 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 4.
	No: Repair short to GND between DEF: SMH Relay pin-30 and 4-pin connector pin-1. Replace fuse. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

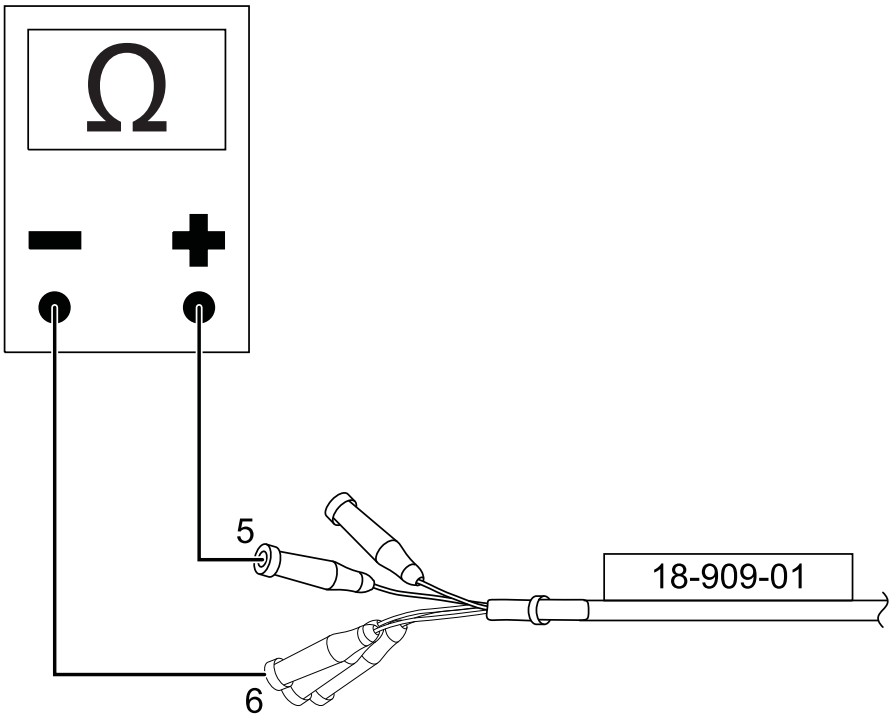


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Figure 165 Test 4 DEF: SMH Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module and leave vehicle harness disconnected.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-5 and pin-6.	Between 1 and 5 ohms
Decision	
Is resistance between 1 and 5 ohms?	Yes: Replace fuse. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.
	No: Replace DEF supply module and replace DEF: SMH Relay fuse. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.



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Figure 166 Test 5 DEF: SMH Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module and leave vehicle harness disconnected.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-5 and pin-6.	Between 1 and 5 ohms
Decision	
Is resistance between 1 and 5 ohms?	Yes: Go to Test 6.
	No: Replace DEF supply module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

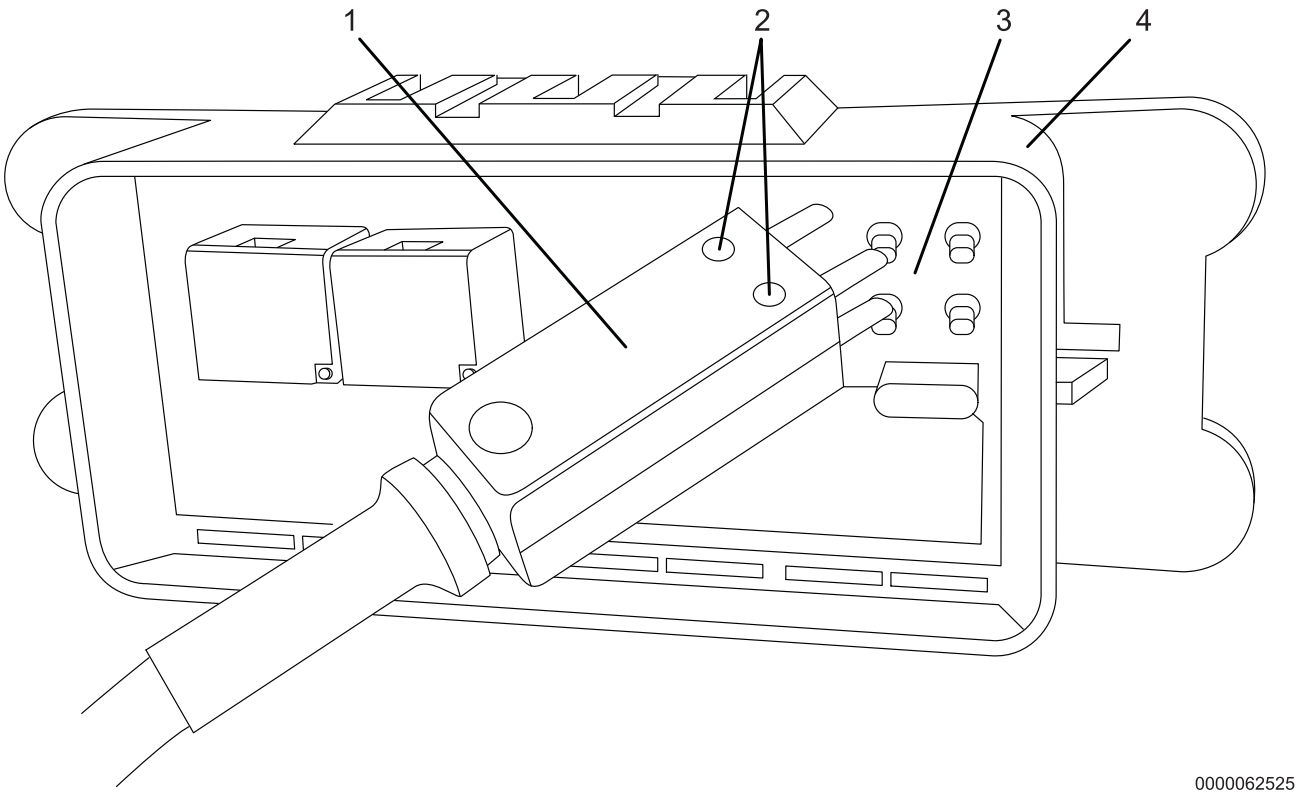


Figure 167 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

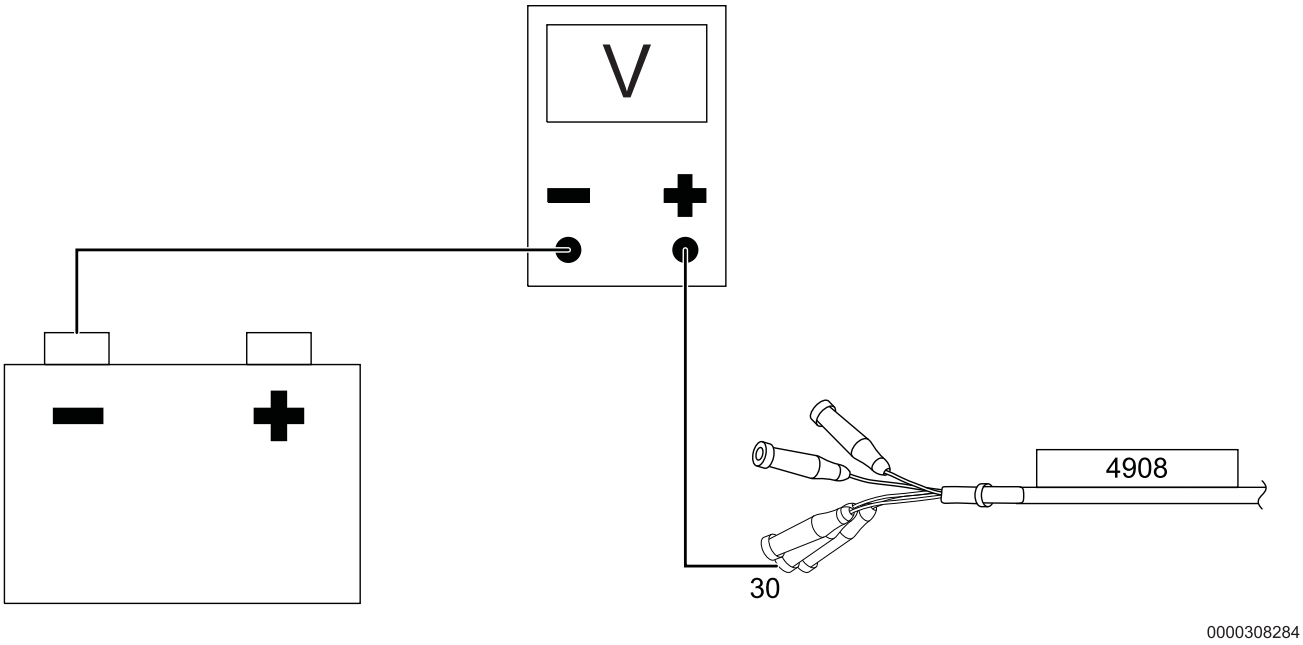


Figure 168 Test 6 DEF: SMH Relay Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install DEF: SMH Relay into Breakout Harness ZTSE4908. D. Install Breakout Harness ZTSE4908 into PDM and leave PDM connector disconnected. E. Key ON.

Test 6	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-30 and known good ground.	Voltage within 0.5 volts of B+
Decision	
Is voltage within 0.5 volts of B+?	Yes: Go to Test 7.
	No: Repair Open or high resistance in PWR circuit to DEF: SMH Relay terminal 30. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

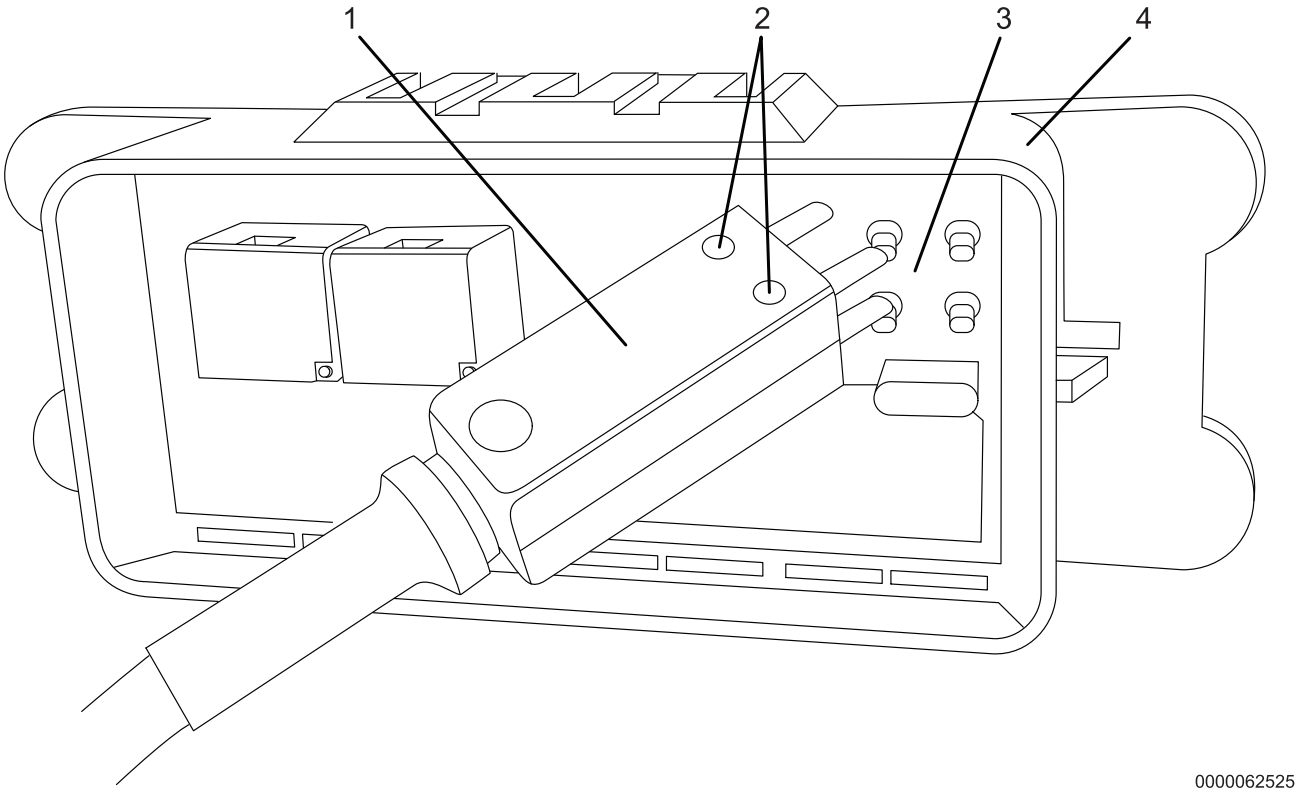


Figure 169 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

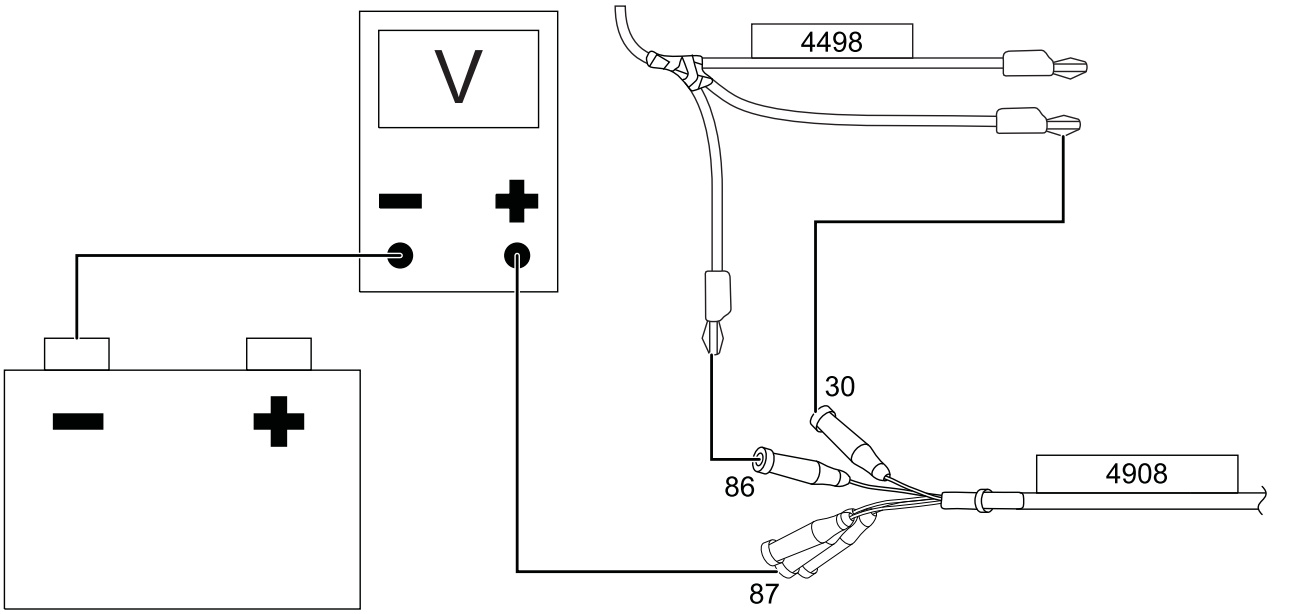


Figure 170 Test 7 DEF: SMH Relay Circuit Voltage Check

Test 7 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install DEF: SMH Relay into Breakout Harness ZTSE4908. D. Install Breakout Harness ZTSE4908 into PDM. E. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4908 pin-30 to pin-86. F. Key ON.

Test 7	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-87 and known good ground.	Voltage within 0.5 volts of B+
Decision	
Is voltage within 0.5 volts of B+?	Yes: Go to Test 8.
	No: Replace DEF: SMH Relay. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

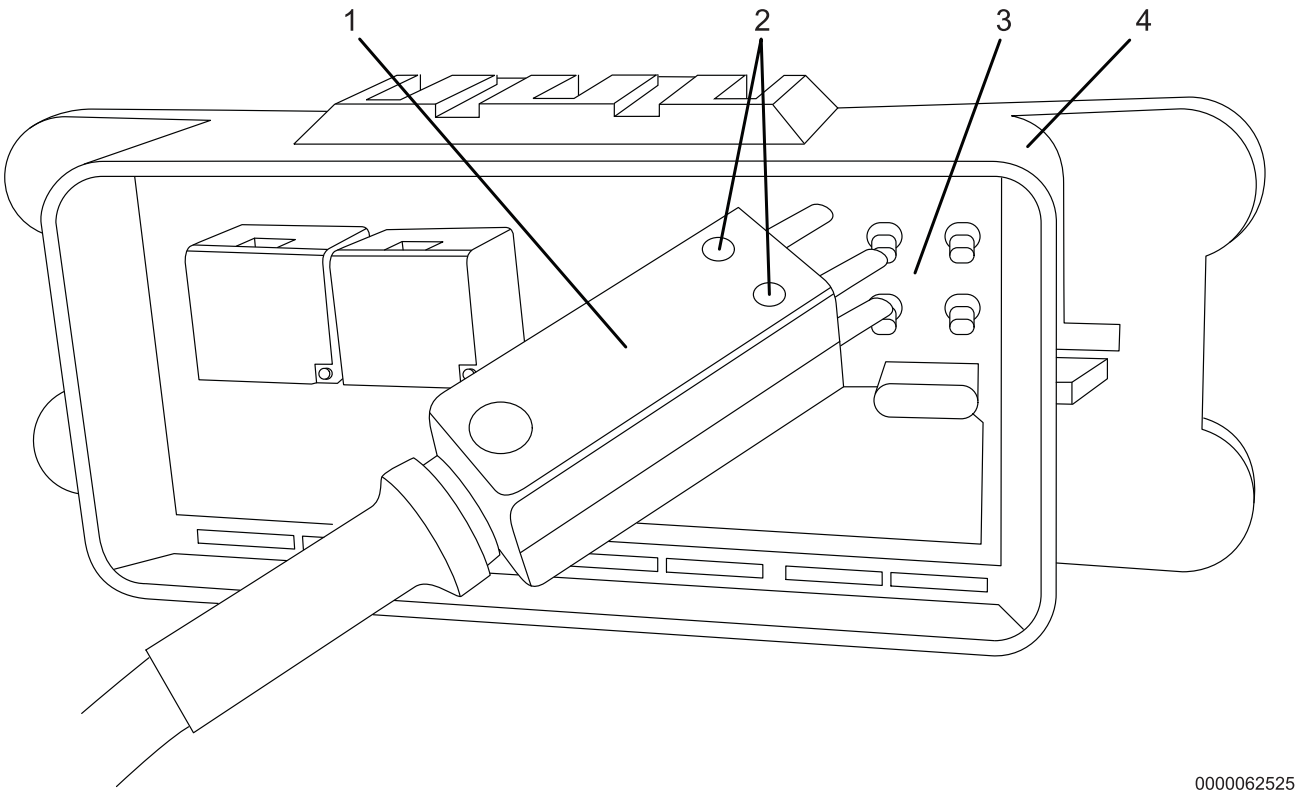


Figure 171 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

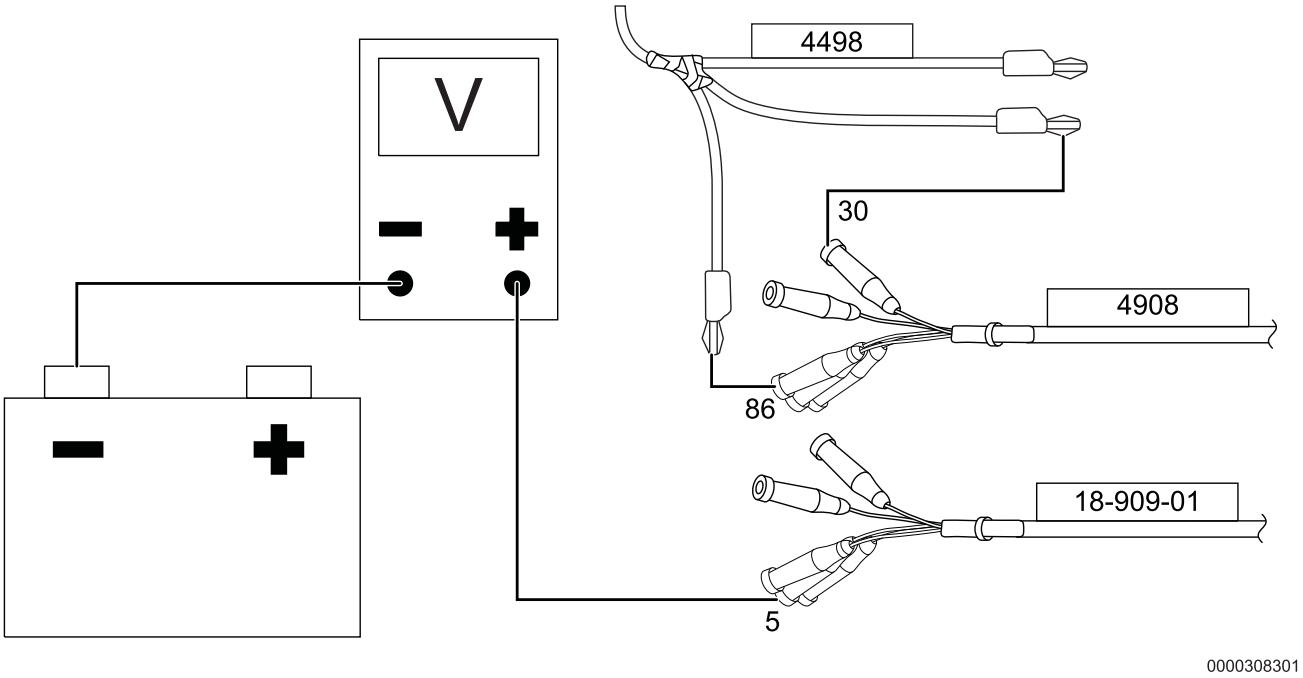


Figure 172 Test 8 DEF: SMH Circuit Voltage Check

Test 8 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 between DEF supply module vehicle harness connector and DEF supply module. C. Install DEF: SMH Relay into Breakout Harness ZTSE4908. D. Install Breakout Harness ZTSE4908 into PDM. E. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4908 pin-30 to pin-86. F. Key ON.

Test 8	Specification
Use DMM to measure voltage between Breakout Harness 18-909-01 pin-5 and known good ground.	Voltage within 0.5 volts of B+
Decision	
Is voltage within 0.5 volts of B+?	Yes: Repair Open between DEF supply module pin-6 and ground. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest SPN 5745 FMI 4.
	No: Repair Open between DEF: SMH Relay pin-87 and DEF supply module pin-5. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5745 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5745 FMI 4 fault code diagnostics.

SPN 5745 FMI 18 - DEF Supply Module Heater below Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) supply module failed to reach target temperature within a predetermined time from the start of DEF supply module heating.	DEF supply module heating is active for between 10 an 120 minutes (specific time depends on initial temperature), and supply module temperature remains less than 25°F (-4°C)	SPN 3361 FMI 2 (DEF: SP), SPN 4337 FMI 2 (DEF: SP Temp), and SPN 5746 FMI 3 and 4 (DEF: SMH Relay) are inactive Heating of the DEF supply module is required A valid DEF supply module temperature value is available, and a valid DEF Supply Module Heater (DEF: SMH) temperature value is available from the DEF supply module Ambient air temperature < 41°F (5°C)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Diesel Exhaust Fluid (DEF) supply module has failed to rise to greater than 25°F (-4 °C) after a predetermined time. DEF injection into aftertreatment system will be disabled. Engine torque will be reduced if engine is operated for a limited period of time with fault code active. Engine torque will be severely reduced, and vehicle speed will be limited after extended engine operation with fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 171 FMI 2, 3, and 4 (AAT) • SPN 5746 FMI 3 and 4 (DEF: SMH Relay)	• SPN 3361 FMI 2 (DEF: SP)	• SPN 4337 FMI 2 (DEF: SP Temp)	• SPN 5745 FMI 3 and 4 (DEF: SMH)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SMH ground (GND) circuit high resistance
- DEF: SMH power circuit high resistance
- Failed DEF supply module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 533). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5745 FMI 18.

Step 2	Inspect connections at DEF: SMH sensor connector.	Decision
A. Key OFF. B. Disconnect DEF: SMH sensor connector. C. Check DEF: SMH sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: SMH sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5745 FMI 18.

Pin-Point Tests (SPN 5745 FMI 18)

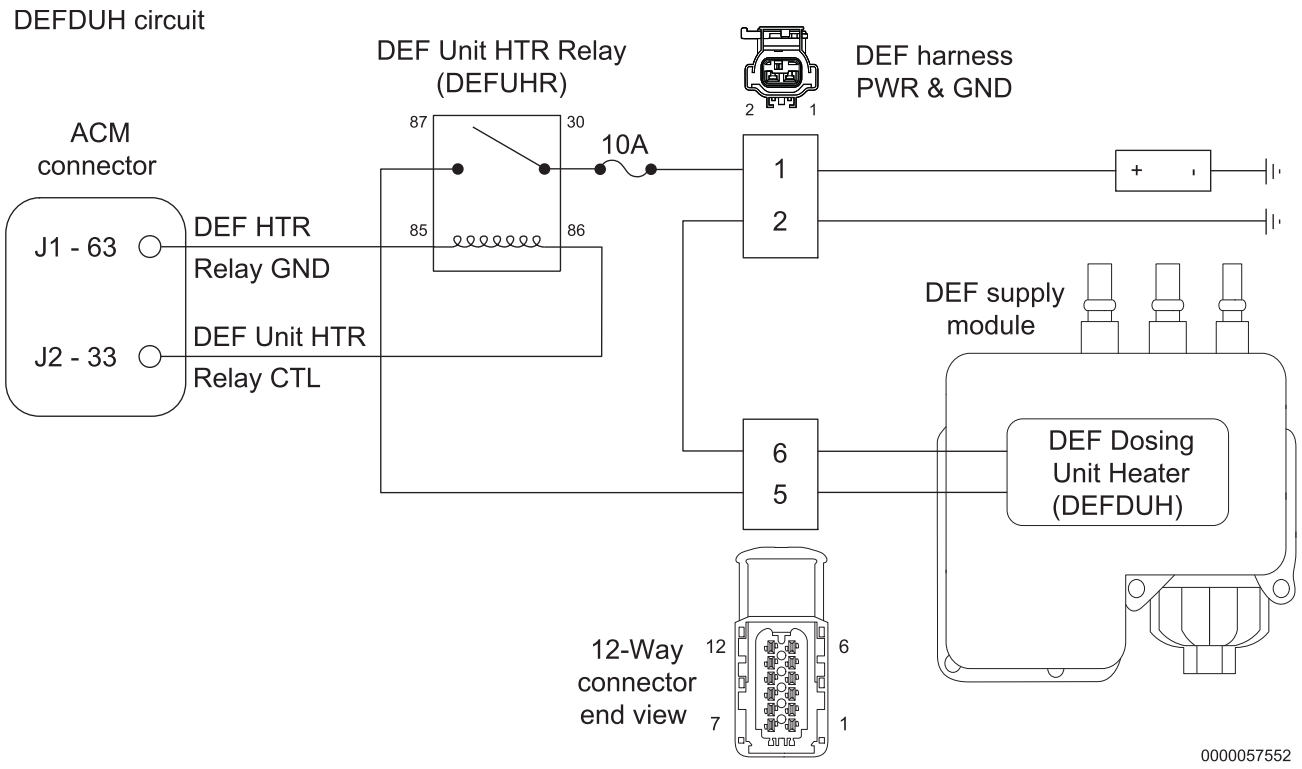


Figure 173 DEF: SMH Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-909-01
- Breakout Harness ZTSE4760A
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

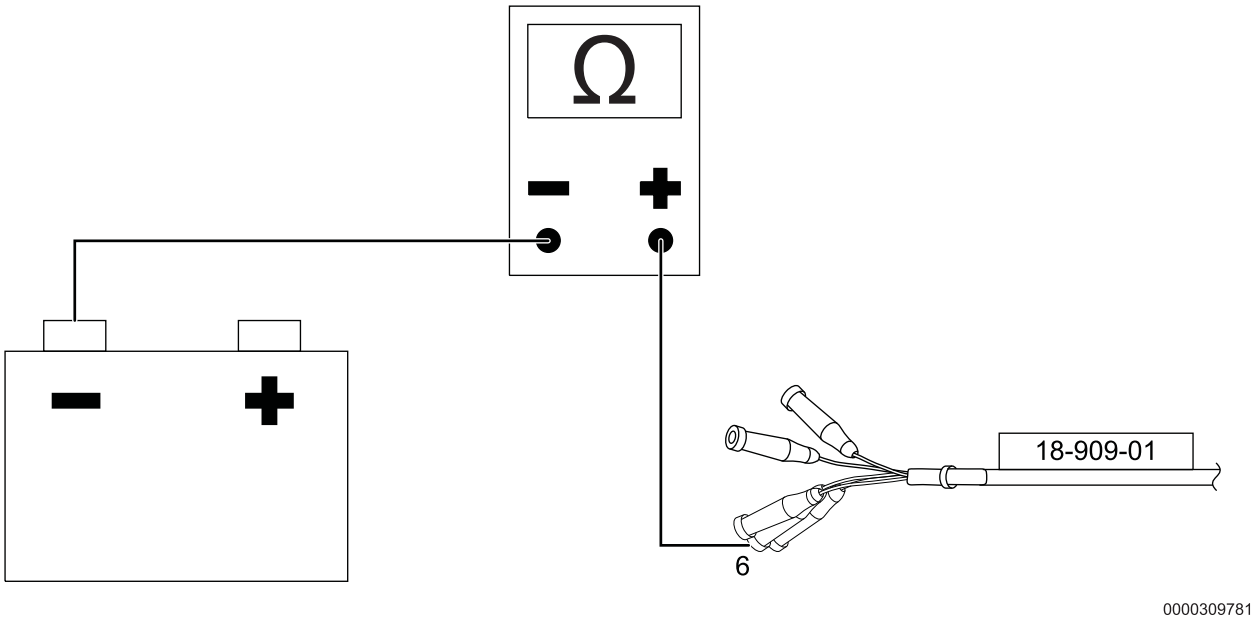


Figure 174 Test 1 DEF: SMH Sensor Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module harness, and leave module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-6 and ground (GND).	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 2.
	No: Repair high resistance in DEF: SMH ground (GND) circuit between DEF supply module pin-6 and GND. When repairs are complete, retest for SPN 5745 FMI 18.

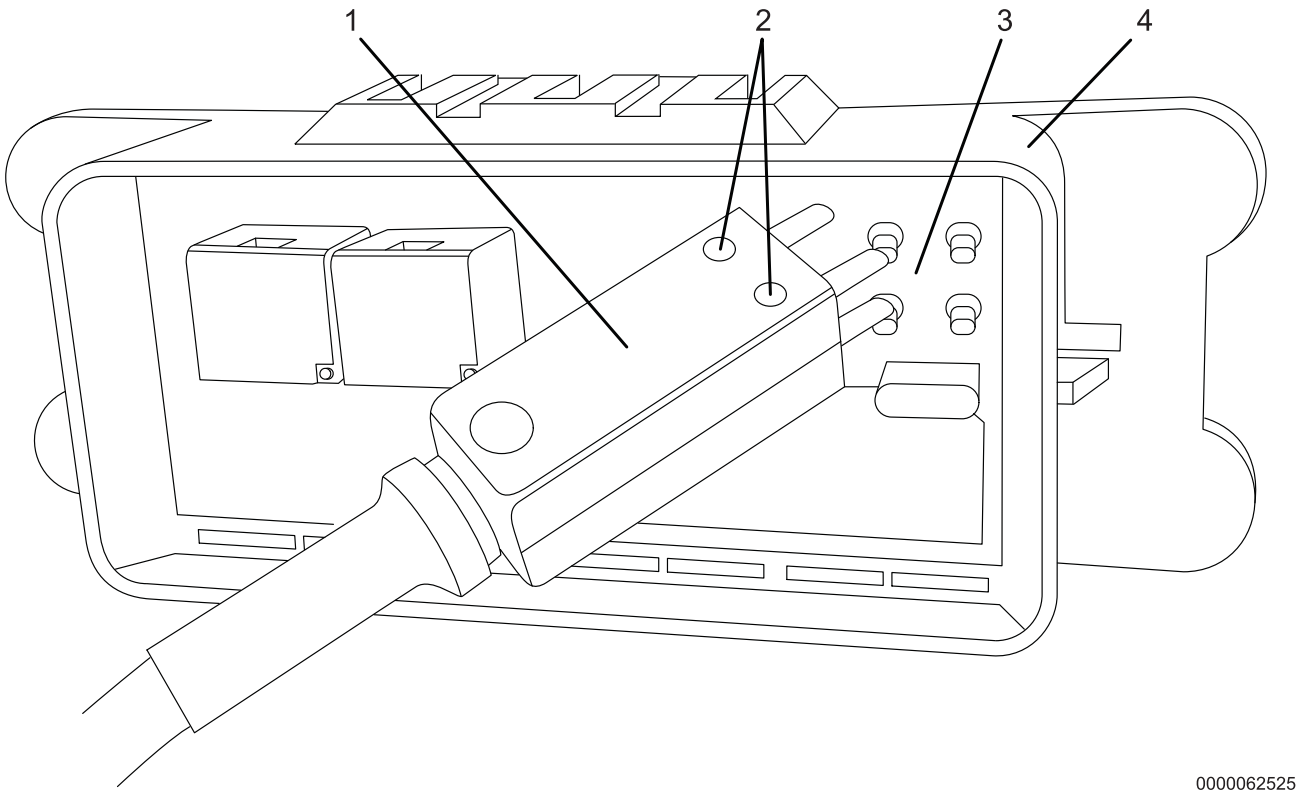


Figure 175 Installation of Breakout Harness ZTSE4908 (Typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. Power Distribution Module (PDM)

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with the dimples toward the top of the Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF. B. Remove Diesel Exhaust Fluid Supply Module Heater Relay (DEFSMR). C. Install Breakout Harness ZTSE4908 into Power Distribution Module (PDM), and leave relay disconnected. D. Connect Electronic Service Tool (EST) with ServiceMaxx™ software to diagnostic port. E. Key-ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Use a Digital Multimeter (DMM) to measure resistance between Breakout Harness 18-909-01 pin-5 and Breakout Harness ZTSE4908 pin-87.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3.
	No: Repair high resistance in Diesel Exhaust Fluid Supply Module Heater Relay (DEFSMR) power circuit between pin-5 of Diesel Exhaust Fluid (DEF) supply module connector and pin-87 of DEFSMR. When repairs are complete, retest for SPN 5745 FMI 18.

Test 3 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid (DEF) harness power (PWR) and ground (GND) connector and install Breakout Harness ZTSE4760A to female side. C. Connect Electronic Service Tool (EST) with ServiceMaxx™ software to diagnostic port. D. Key-ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-30 and Breakout Harness ZTSE4760A pin-1.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace the DEF supply module. When repairs are complete, retest for SPN 5745 FMI 18.
	No: Repair high resistance in Diesel Exhaust Fluid Supply Module Heater Relay (DEFSMR) power circuit between DEF harness PWR and GND pin-1 and DEFSMR pin-30. When repairs are complete, retest for SPN 5745 FMI 18.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5745 FMI 18 fault code diagnostics.

SPN 5798 FMI 2 - DEF Supply Module Heater Temperature erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Module Heater (DEFSMH) temperature sensor is in-range but not rational.	Difference between DEFSMH temperature at Key ON and Intake Air Temperature (IAT) at Key ON > 72°F (22°C) Difference between DEFSMH temperature at Key ON and coolant temperature at Key ON > 72°F (22°C)	Engine is cold soaked 10 hours Block heater not detected Valid DEF supply module temperature value is available Valid DEFSMH temperature value is available Diagnostic has not previously completed during this key cycle Inactive: SPN 3361 FMI 2 (DEF supply pump)

Fault Overview

Fault code sets when the Aftertreatment Control Module (ACM) detects the Diesel Exhaust Fluid Supply Module Heater (DEFSMH) temperature differs from the Engine Coolant Temperature (ECT) and the Intake Air Temperature (IAT) by more than 72°F (22°C) at Key ON.

Lamp Reaction

Malfunction Indicator Lamp (MIL)will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 110 FMI 2, 3, and 4 (ECT1)	• SPN 172 FMI 2, 3, and 4 (IAT)	• SPN 3361 FMI 2, 3, and 4 (DEF Supply Pump)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEFSP Temp / CTL circuit intermittent short to GND.
- DEFSP Temp / CTL circuit intermittent short to PWR
- DEFSP Temp / CTL circuit intermittent Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, Diagnostic Trouble Code (DTC) list for Associated Faults(page 540). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5798 FMI 2.

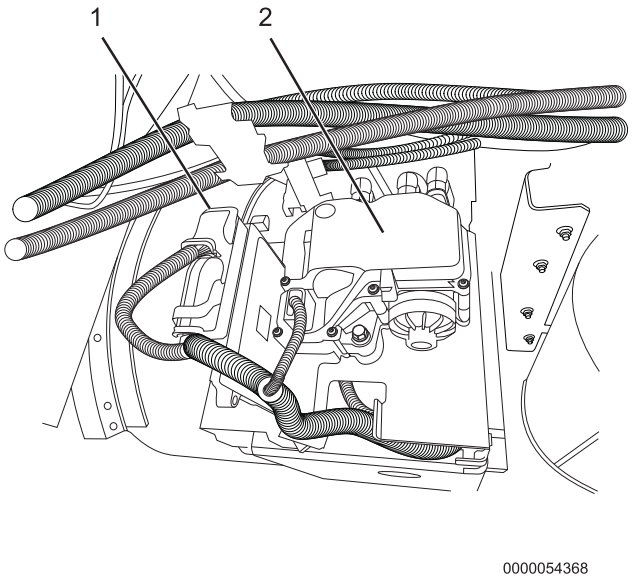


Figure 176 Diesel Exhaust Fluid (DEF) Supply Module Location (Typical)

1. DEF supply module

Step 2	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connectors. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DEF supply module connectors, harnesses, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5798 FMI 2.

Step 3	Inspect connections at ACM.	Decision
A. Key OFF. B. Disconnect ACM connectors. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5798 FMI 2.

Pin-Point Tests (SPN 5798 FMI 2)

DEF: SP and Temperature Sensor Circuit

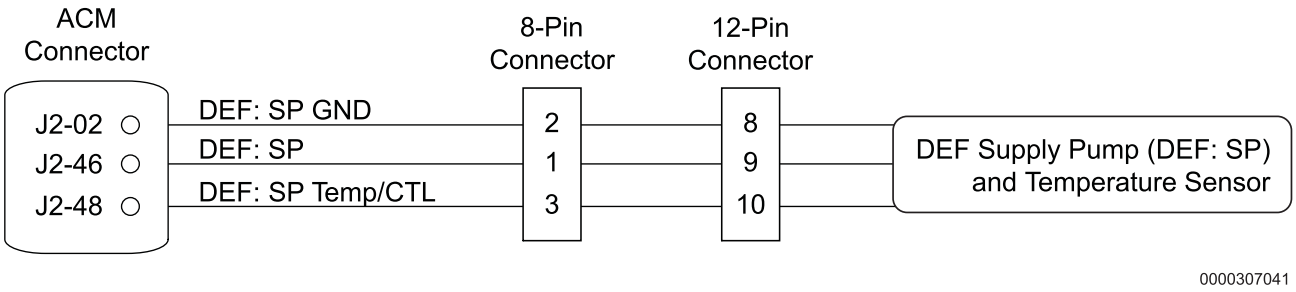


Figure 177 DEFSP Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-Pin Breakout Box 00-00956-08
- Breakout Harness 18-909-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)

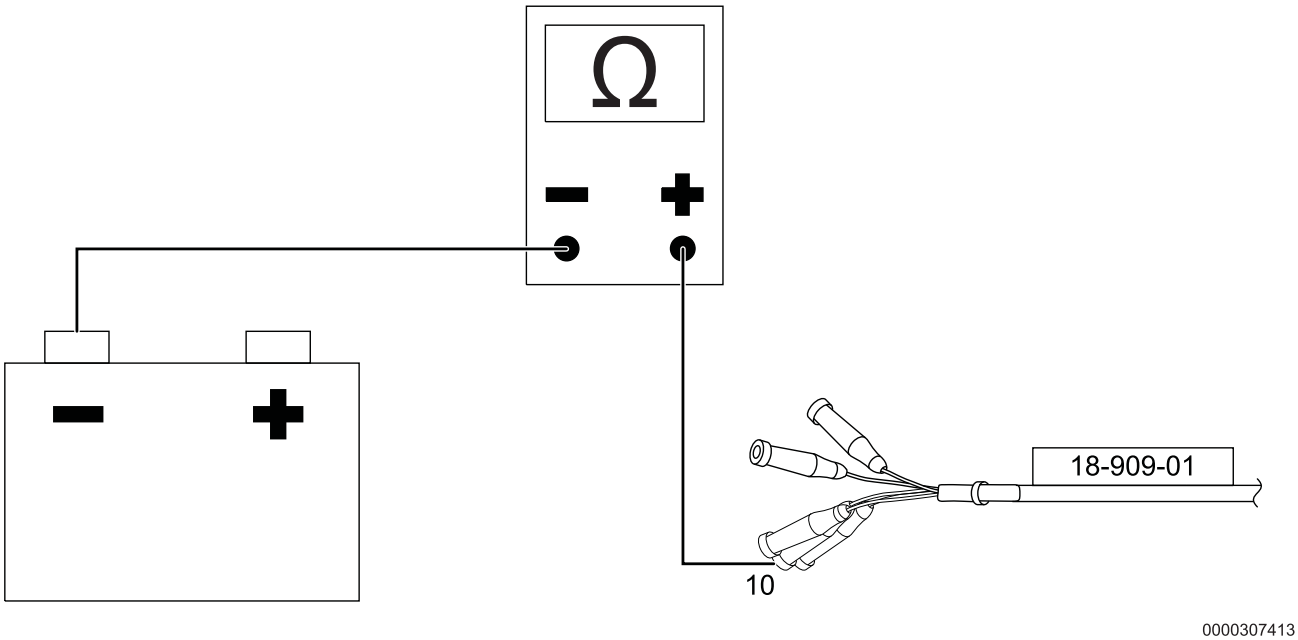


Figure 178 Test 1 Diesel Exhaust Fluid Supply Pump (DEFSP) Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Control Module (ACM) and leave ACM disconnected. C. Connect Breakout Harness 18-909-01 to Diesel Exhaust Fluid (DEF) supply module vehicle harness connector and leave supply module disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and a known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair intermittent short to ground between DEF supply module pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 2.

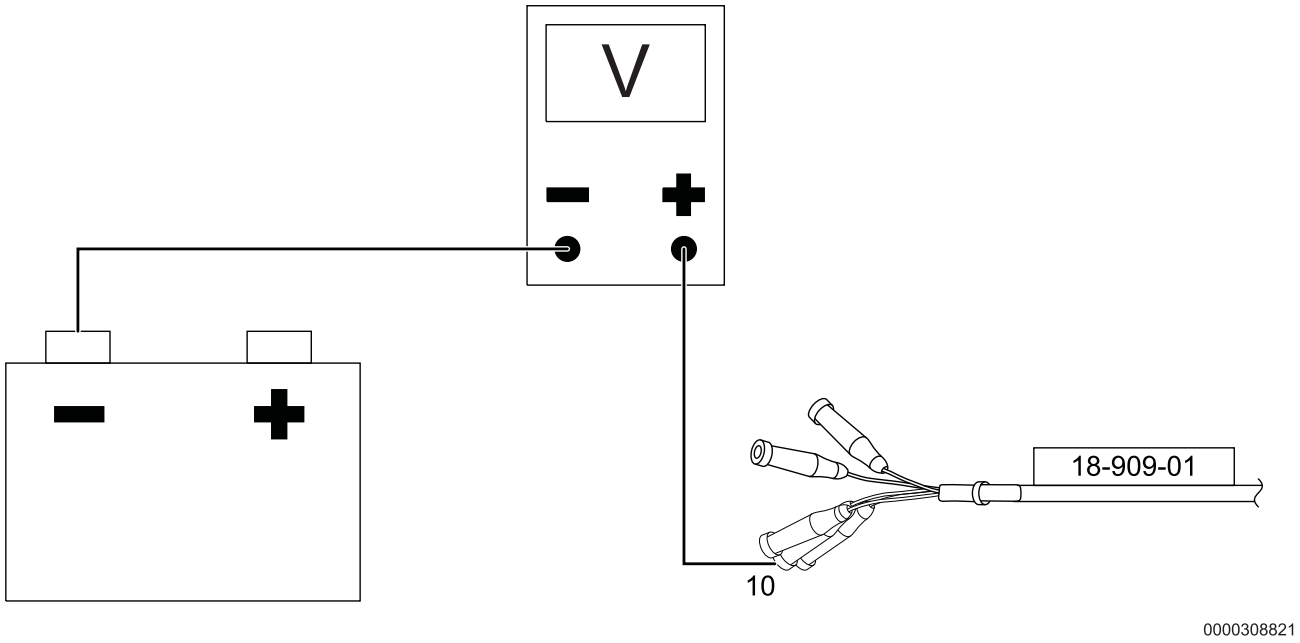


Figure 179 Test 2 Diesel Exhaust Fluid Supply Pump (DEFSP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect ACM and leave ACM disconnected. C. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave supply module disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-909-01 pin-10 and a known good ground.	Less than 1 volt
Decision	
Is voltage less than 1 volt?	Yes: Go to Test 2.
	No: Repair intermittent short to power between DEF supply module pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 2.

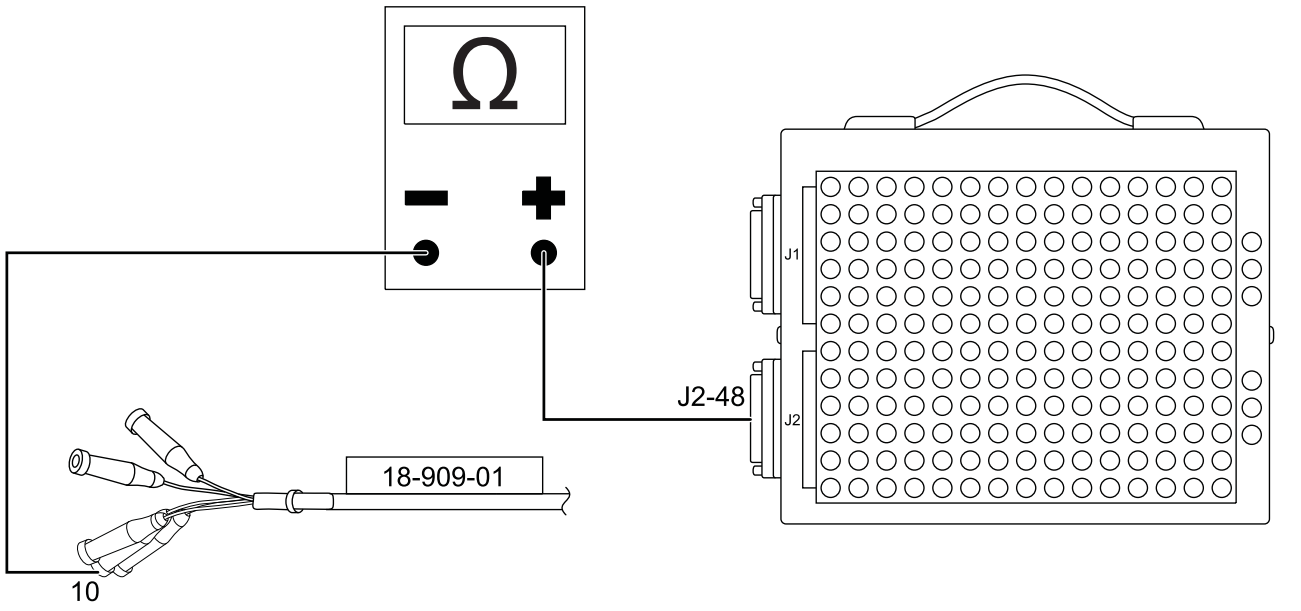


Figure 180 Test 3 Diesel Exhaust Fluid (DEF) Supply Pump Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module harness, and leave supply module disconnected. C. Connect 180-Pin Breakout Box 00-00956-08 and ACM Breakout Harness 18-537-01 to ACM vehicle harness connector, and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and 180-pin Breakout Box 00-00956-08 pin J2-48.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace the DEF supply module. After repairs are complete, retest for SPN 5798 FMI 2.
	No: Repair intermittent open or high resistance between DEF supply module pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 2.

End Diagnostic Tests
After performing all tests, if SPN 5798 FMI 2 remains, verify if each step was completed correctly, and the proper decision was made. Notify supervisor for further action.

SPN 5798 FMI 10 - DEF Supply Module Heater Temperature abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Values
DEF Supply Module Heater (DEF: SMH) temperature is in range but not rational (not heating).	Difference between maximum and minimum DEF: SMH temperature < 9°F (5°C) within 10 minutes.	Valid Diesel Exhaust Fluid (DEF) supply module temperature value is available Initial DEF supply module heater temperature at Key ON < 25°F (-4°C) DEF supply module heater is active Diagnostic has not previously completed during this key cycle Key-On Engine-Running (KOER) Inactive: SPN 3361 FMI 2 Diesel Exhaust Fluid Supply Pump (DEF: SP); SPN 5746 FMI 3 and 4 Diesel Exhaust Fluid Unit Heater Relay (DEFSMR); SPN 5798 FMI 2, (DEF: SMH) Temperature

Fault Overview

Fault code sets when the Aftertreatment Control Module (ACM) detects the DEF Supply Module Heater (DEF: SMH) is not heating properly.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 171 FMI 2, 3, and 4 (AAT) • SPN 5746 (DEF: UHR)	• SPN 3361 FMI 2 (DEF: SP Signal) • SPN 5798 (DEF: SMH Temp)	• SPN 4337 FMI 2 (DEF: SP Temp)	• SPN 5745 (DEF: SMH)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SP Temp / CTL circuit intermittent short to GND
- DEF: SP Temp / CTL circuit intermittent short to PWR
- DEF: SP Temp / CTL intermittent Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 547). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5798 FMI 10.

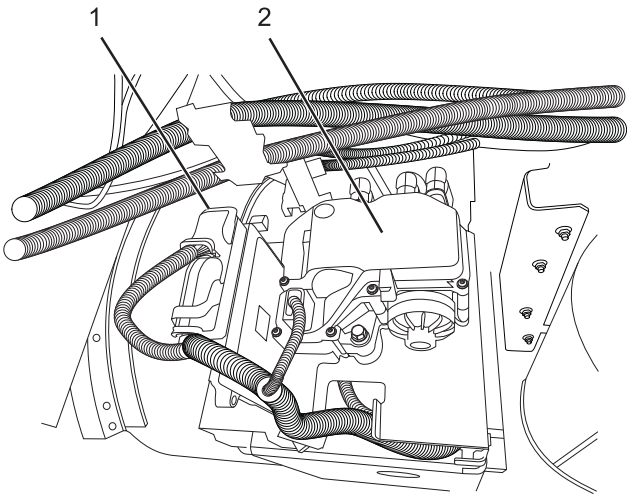


Figure 181 Diesel Exhaust Fluid (DEF) Supply Module Location (Typical)

1. Aftertreatment Control Module (ACM)
2. DEF supply module

Step 2	Inspect connections at Diesel Exhaust Fluid (DEF) supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connectors. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DEF supply module connectors, harnesses, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5798 FMI 10.

Step 3	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Disconnect ACM connectors. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. D. Leave connector J2 unplugged. Are the ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5798 FMI 10.

Pin-Point Tests (SPN 5798 FMI 10)

DEF: SP and Temperature Sensor Circuit

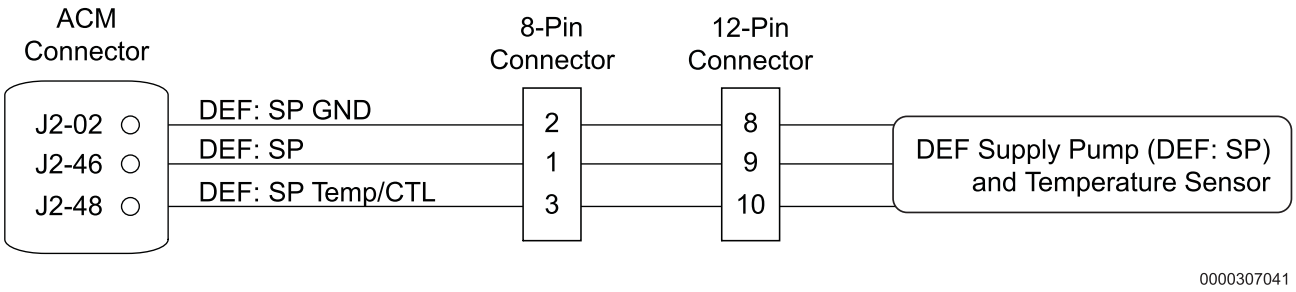


Figure 182 DEF:SP Temperature Sensor Circuit Diagram

Tools Required

- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)
- 180-Pin Breakout Box 00-00956-08

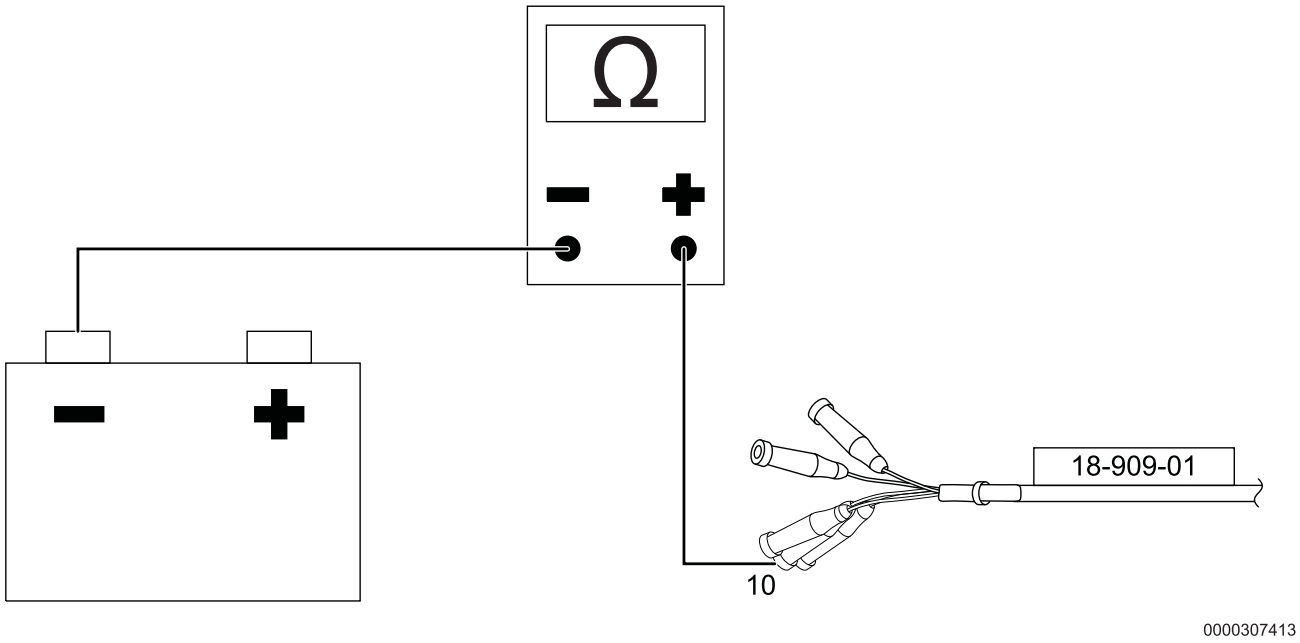


Figure 183 Test 1 DEFSP Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Aftertreatment Control Module (ACM) and leave ACM disconnected. C. Connect Breakout Harness 18-909-01 to Diesel Exhaust Fluid (DEF) supply module vehicle harness connector and leave supply module disconnected.

Test 1	Specification
Use a Digital Multimeter (DMM) to measure resistance between Breakout Harness 18-909-01 pin-10 and a known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair intermittent short to GND between DEF supply module connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 10.

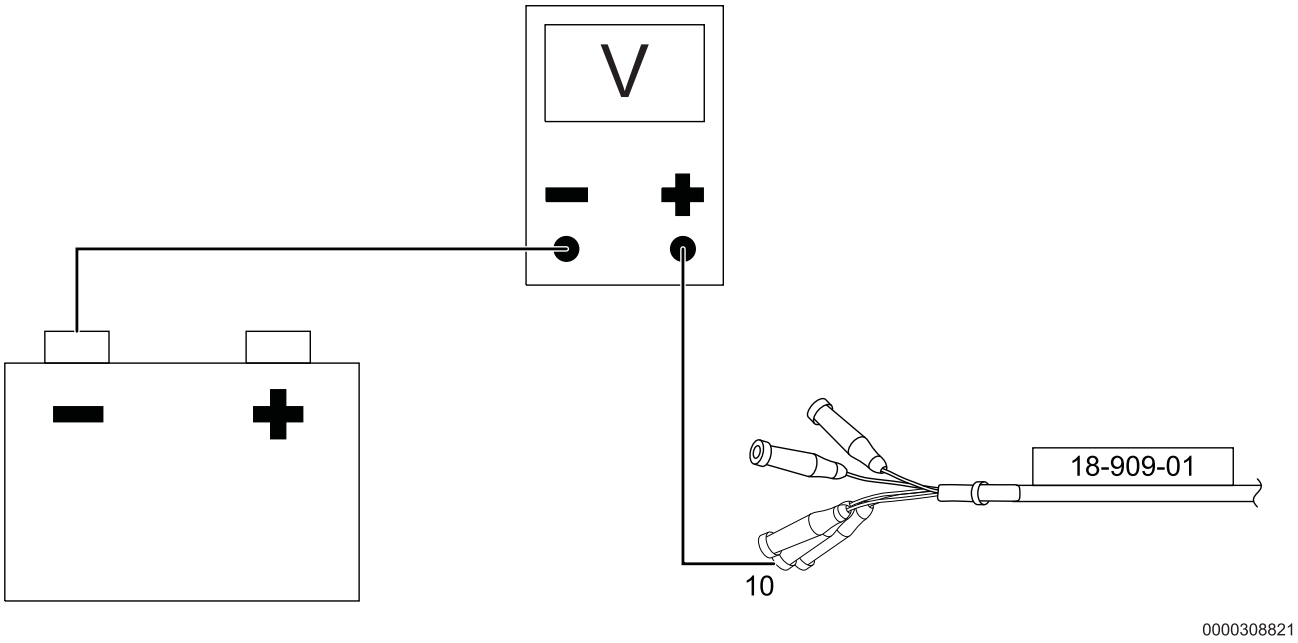


Figure 184 Pin-Point Test 2 DEFSP / Temp Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect ACM and leave ACM disconnected. C. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave supply module disconnected. D. Key ON.

Test 2	Specification
Use a DMM to measure voltage between Breakout Harness 18-909-01 pin-10 and a known good ground.	Less than 1 volt
Decision	
Is voltage less than 1 volt?	Yes: Go to Test 3.
	No: Repair intermittent short to PWR between DEF supply module connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 10.

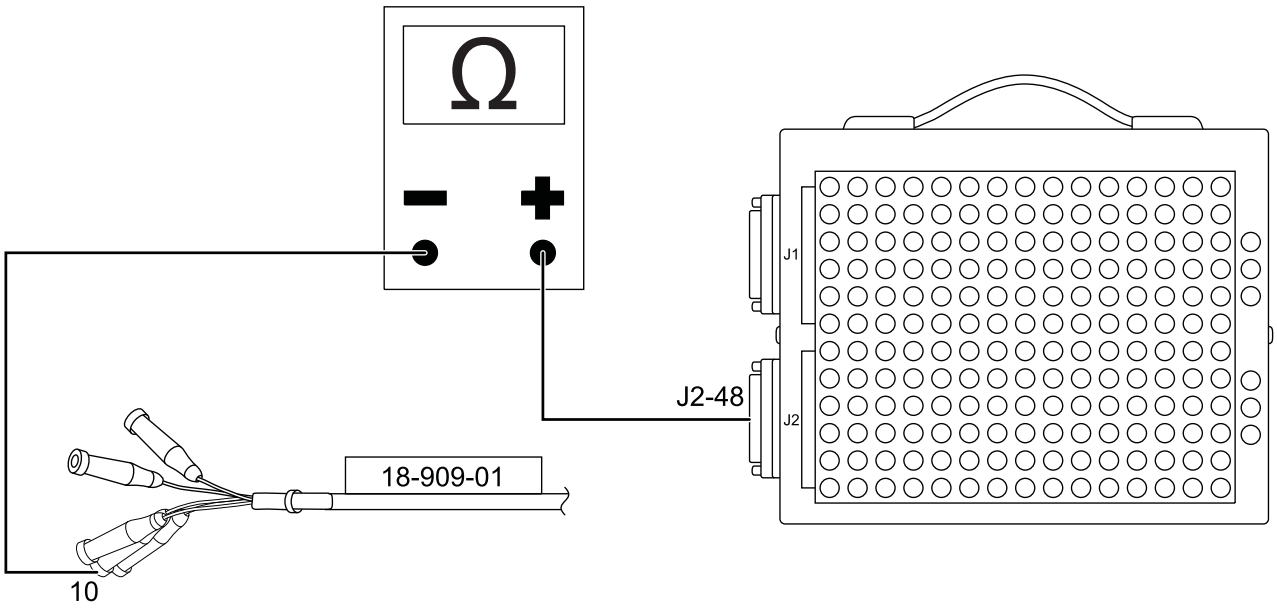


Figure 185 Pin-Point Test 3 DEFSP / Temp Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module harness, and leave supply module disconnected. C. Connect 180-Pin Breakout Box 00-00956-08 and ACM Breakout Harness 18-537-01 to ACM vehicle harness connector, and leave ACM disconnected.

Test 3	Specification
Use a DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and Breakout Box pin J2-48.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, retest for SPN 5798 FMI 10.
	No: Repair intermittent Open or high resistance between DEF supply module connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 5798 FMI 10.

End Pin-Point Tests
After performing all tests, if SPN 5798 FMI 10 remains, verify if each step was completed correctly, and the proper decision was made. Notify supervisor for further action.

DEF: DU (Diesel Exhaust Fluid Doser Unit) Sensor

Overview of DEF: DU Sensor Group

SPN	FMI	Description
5394	2	DEF Dosing below desired (Low NOx conversion across SCR) (page 555)
5394	5	DEF Doser Valve open load/circuit (page 559)
5394	7	DEF Dosing Unit - Mechanical system not responding (page 568)

Overview

Aftertreatment Diesel Exhaust Fluid Doser Unit (DEF: DU) is controlled by Aftertreatment Control Module (ACM). When ACM commands DEF dosing, it opens doser valve and allows DEF to be sprayed into exhaust stream.

SPN 5394 FMI 2 - DEF Dosing below desired (Low NOx conversion across SCR)

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Doser Unit (DEF: DU) signal data erratic, intermittent, or incorrect.	Nitrogen Oxide (NOx) conversion rate less than Aftertreatment Control Module (ACM) predetermined value	Diesel Particulate Filter (DPF) filter regeneration procedure running Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxides (NOx) conversion rate of aftertreatment system is less than expected. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled, and engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3361 FMI 2, 3, and 4 (DEF: SP)	• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 4340 FMI 3 and 5 (DEF: L1HC)	

Fault Facts

Monitor for this fault code runs only during Diesel Particulate Filter (DPF) filter regeneration procedure.
This fault is used to assist in troubleshooting following fault codes: SPN 4094 FMI 31 (AFT System), SPN 4364 FMI 18 (AFT System), and SPN 4794 FMI 31 (AFT System).

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust Leak(s)
- Contaminated Diesel Exhaust Fluid (DEF)
- DEF tank, supply module, or doser valve line or connection loose, leaking, frozen, or damaged
- Failed Diesel Exhaust Fluid Doser Unit (DEF: DU)
- Restricted DEF supply module filter
- Restricted DEF: DU

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 555). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5394 FMI 2.

Step 2	Inspect exhaust system.	Decision
Inspect exhaust system for leaks and physical damage. Is exhaust system free of leaks and physical damage?		Yes: Go to Step 3. No: Repair leaks or physical damage. After repairs are complete, retest for SPN 5394 FMI 2.

Step 3	Inspect connections at Diesel Exhaust Fluid Doser Unit (DEF: DU) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEF: DU sensor module connector. C. Check DEF: DU sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DEF: DU sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 5394 FMI 2.

Step 4	Inspect Diesel Exhaust Fluid (DEF) tank and lines.	Decision
Inspect DEF tank and lines for frozen DEF. Are the DEF tank and lines free of frozen DEF?		Yes: Go to Step 5. No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 5394 FMI 2.

Step 5	Inspect Diesel Exhaust Fluid (DEF) quality.	Decision
Check DEF quality. Obtain a sample of DEF. Visually inspect for contamination and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Are the DEF tank and lines free of frozen DEF?		Yes: Perform Pin-Point Tests. No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 5394 FMI 2.

Pin-Point Tests (SPN 5394 FMI 2)

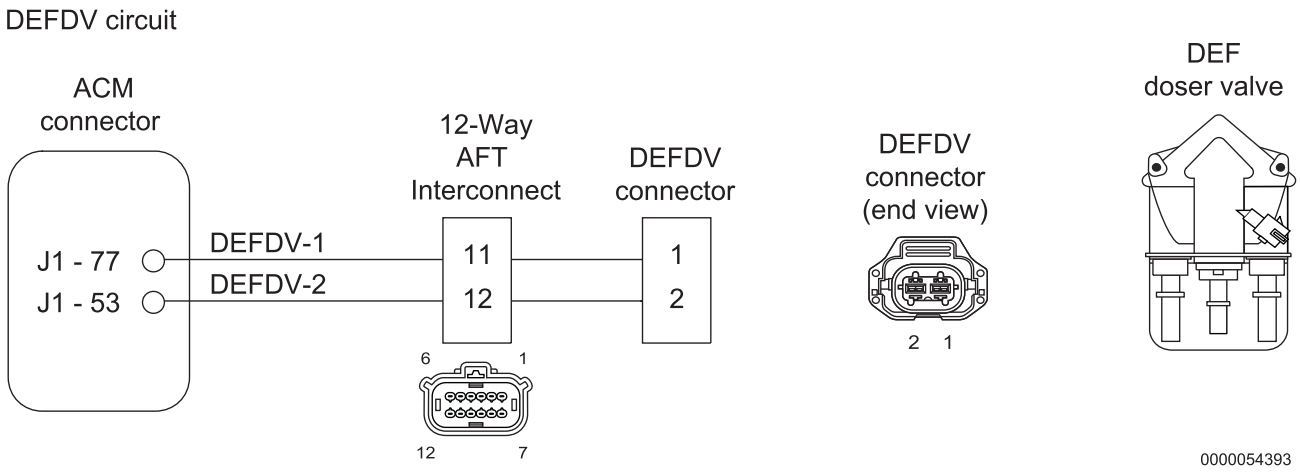


Figure 186 Diesel Exhaust Fluid Doser Unit (DEF: DU) Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). C. Key-ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Use the Electronic Service Tool (EST) to perform KOEO DEF Supply Pump Override Test(page 2165).	Less than 5 ohms
Decision	
Is the Diesel Exhaust Fluid Doser Unit (DEF: DU) operating correctly?	Yes: Replace DEF supply module filter and clean DEF supply module. Repeat Test 2. If DEF: DU still does not operate correctly, replace DEF: DU . After repairs are complete, retest for SPN 5394 FMI 2.
	No: Replace DEF: DU . After repairs are complete, retest for SPN 5394 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5394 FMI 2 fault code diagnostics.

SPN 5394 FMI 5 - DEF Doser Valve open load/circuit

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Doser Unit (DEF: DU) current below normal or open circuit. Open signal voltage detected at the DEF: DU.	Resistance between DEF: DU pin-1 or DEF: DU pin-2 and ground < 0.2 ohms Resistance between pin J1-53 and pin J1-77 > 1,000,000 ohms Resistance between DEF: DU pin-2 and battery positive < 0.2 ohms	DEF: DU is turned off

Fault Overview

Fault codes sets when Aftertreatment Control Module (ACM) detects that Diesel Exhaust Fluid Doser Unit (DEF: DU) circuit is open or shorted. DEF injection into aftertreatment system is disabled, and engine torque will be reduced if fault is active for a limited period of time. Engine torque will be severely reduced and vehicle speed limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Exhaust Fluid Doser Unit (DEF: DU)
- DEF: DU pin-1 circuit open or high resistance
- DEF: DU pin-1 short to ground (GND)
- DEF: DU pin-2 circuit open or high resistance
- DEF: DU pin-2 short to GND
- DEF: DU pin-1 shorted to DEF: DU pin-2
- DEF: DU pin-2 short to power (PWR)

Step 1	Check active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5394 FMI 5. Does EST DTC show free of SPN 5394 FMI 5 as active?		Yes: Go to Step 2. No: Drive vehicle and retest for SPN 5394 FMI 5. If fault does not set again, notify supervisor for further action.

Step 2	Inspect connections at Diesel Exhaust Fluid Doser Unit (DEF: DU) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEF: DU sensor module connector. C. Check DEF: DU sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DEF: DU sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair or replace failed line or connection. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Step 3	Inspect connections at Aftertreatment Control Module (ACM) sensor module connector.	Decision
A. Key OFF. B. Disconnect ACM sensor module connector. C. Check ACM sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair or replace failed line or connection. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Pin-Point Tests (SPN 5394 FMI 5)

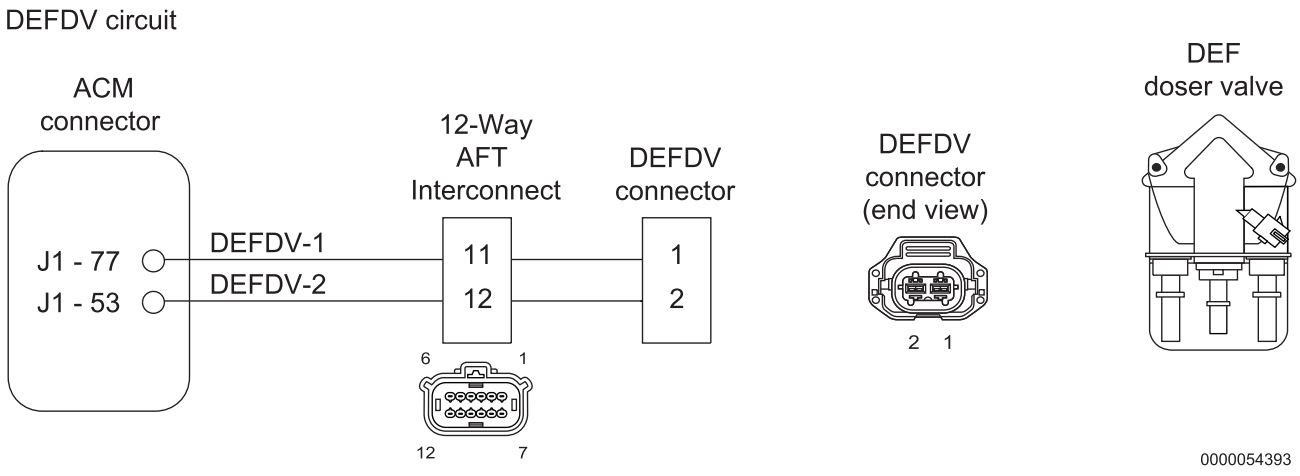


Figure 187 Diesel Exhaust Fluid Doser Unit (DEF: DU) Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- Aftertreatment Control Module (ACM) Breakout Harness 18-537-01
- Breakout Harness ZTSE4828
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to Diesel Exhaust Fluid Doser Unit (DEF: DU) and leave DEFDV disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4828 pin-1 and ground (GND).	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to ground between DEF: DU connector pin-1 and Aftertreatment Control Module (ACM) connector pin J1-77. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to DEF: DU and leave DEF: DU disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4828 pin-2 and ground (GND).	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Repair short to ground between DEF: DU connector pin-2 and ACM connector pin J1-53. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to DEF: DU and leave DEF: DU disconnected. C. Connect 180-pin Breakout Box 00-00956-08 with Breakout Harness18-537-01 to ACM and leave module disconnected. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4828 pin-1 and 180-pin Breakout Box 00-00956-08 pin J1-77.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 4.
	No: Repair Open between DEF: DU connector pin-2 and ACM connector pin J1-77. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to DEF: DU and leave DEF: DU disconnected. C. Connect 180-pin Breakout Box 00-00956-08 with Breakout Harness18-537-01 to ACM and leave module disconnected. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 4	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4828 pin-1 and 180-pin Breakout Box 00-00956-08 pin J1-53.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 5.
	No: Repair Open between DEF: DU connector pin-2 and ACM connector pin J1-53. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to DEF: DU and leave DEF: DU disconnected. C. Connect 180-pin Breakout Box 00-00956-08 with Breakout Harness18-537-01 to ACM and leave module disconnected. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4828 pin-1 and pin-2.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short between DEF: DU connector pin-1 and pin-2. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4828 to Diesel Exhaust Fluid Doser Valve (DEFDV) and leave DEFDV disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key-On Engine-Off (KOEO). Log in to ServiceMaxx™ software.

Test 6	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4828 pin-2 and ground (GND).	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Replace DEFDV. After repairs are complete, retest for SPN 5394 FMI 5.
	No: Repair short to power between DEFDV pin-2 and ACM connector J1-53. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5394 FMI 5 fault code diagnostics.

SPN 5394 FMI 7 - DEF Dosing Unit - Mechanical system not responding

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Dosing Valve (DEFEV) is mechanically stuck closed or open based on the minimum pressure variation during injection.	Difference between the maximum and minimum Diesel Exhaust Fluid (DEF) supply pressure within one injection cycle < 4 psi (30 kPa) (gauge) for greater than or equal to 2 out of 3 times within each set of diagnostic tests	SPN 3361 FMI 3 and 4; SPN 4334 FMI 2, 3, 4, 16, and 18; and SPN 5394 FMI 5 are inactive Exhaust temperature ≥ 32°F (0°C) for 10 seconds Key-On Engine-Running (KOER) Exhaust Mass flow rate ≥ 50 g/hr DEF dosing command ≥ 9.8% DEF dosing command ≤ 88.2% Supply Module Pressure ≥ 58 psi (400 kPa) (gauge)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects mechanical failure of Diesel Exhaust Fluid Doser Valve (DEFDV). Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled, and engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Diesel Exhaust Fluid (DEF) tank, supply module, or doser valve line or connection loose, leaking, or damaged
- Diesel Exhaust Fluid Doser Valve (DEFDV) mechanical failure (stuck open or closed)

Step 1	Check active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5394 FMI 7. Does EST DTC show free of SPN 5394 FMI 7 as active?		Yes: Go to Step 2. No: Drive vehicle and retest for SPN 5394 FMI 7. If fault does not set again, notify supervisor for further action.

Step 2	Inspect connections at Diesel Exhaust Fluid Doser Valve (DEFDV) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEFDV sensor module connector. C. Check Diesel Exhaust Fluid (DEF) tank, DEF supply module, and DEF Doser Valve (DEFDV) lines and connections for: cracks and pitting; and loose, leaking, or damaged connections. Are the DEF tank, DEF supply module, and DEFDV sensor module connectors, harnesses, and terminals clean and undamaged?		Yes: Perform the KOEO Supply Pump Override Test (page 2165). No: Repair or replace failed line or connection. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5394 FMI 7.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5394 FMI 7 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

DEF: LHR (Diesel Exhaust Fluid Line Heater Relay)

Overview of DEF: LHR Sensor Group

SPN	FMI	Description
5491	3	DEF Line Heater Relay Open or short to PWR (page 571)
5491	4	DEF Line Heater Relay short to GND (page 582)

Overview

Diesel Exhaust Fluid Line Heater Relay (DEF: LHR) is used to control DEF Line 1 Heater Control (Supply) (DEF: L1HC), DEF Line 3 Heater Control (Pressure) (DEF: L3HC) and DEF Line 2 Heater Control (Return) (DEF: L2HC), which are wrapped around the DEF suction, pressure, and return lines. Aftertreatment Control Module (ACM) turns line heaters on by controlling DEF: LHR. This is done by sending power through DEF L-HTR Relay CTL circuit to DEF: LHR. DEF: LHR is constantly grounded by ACM through DEF-L HTR Relay GND.

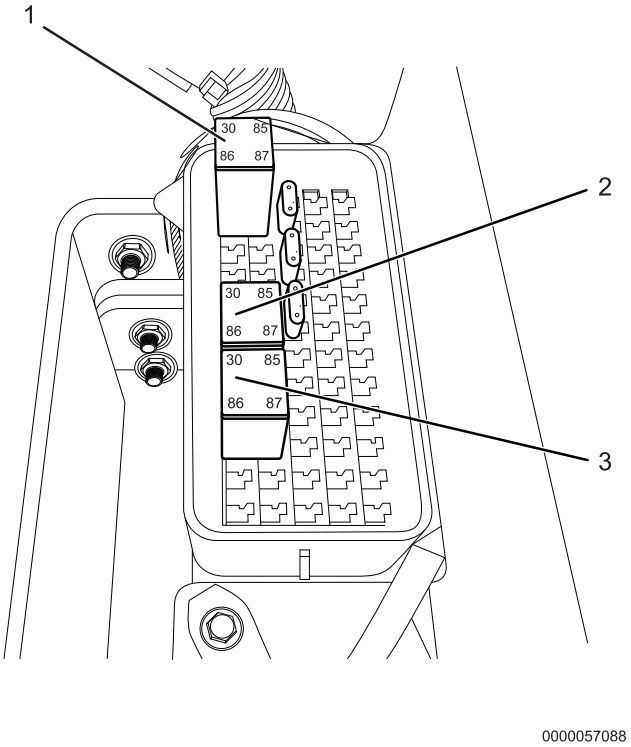


Figure 188 DEF: LHR Location

1. DEF: LHR
2. DEF Supply Module Heater (DEF: SMH) Relay
3. Switched Ignition Relay

SPN 5491 FMI 3 - DEF Line Heater Relay Open or short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Line Heater Relay (DEF: LHR) circuit is shorted to power, open, or high resistance.	Resistance between DEF: LHR Relay control and ground is > 500,000 Ohms. DEF: LHR is shorted to power.	Key ON DEF: LHR is turned ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines voltage signal from DEF: LHR is high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: LHC circuit short to PWR
- DEF: LHC circuit Open or high resistance
- DEF: LHC GND circuit Open or high resistance
- Failed DEF: LHR

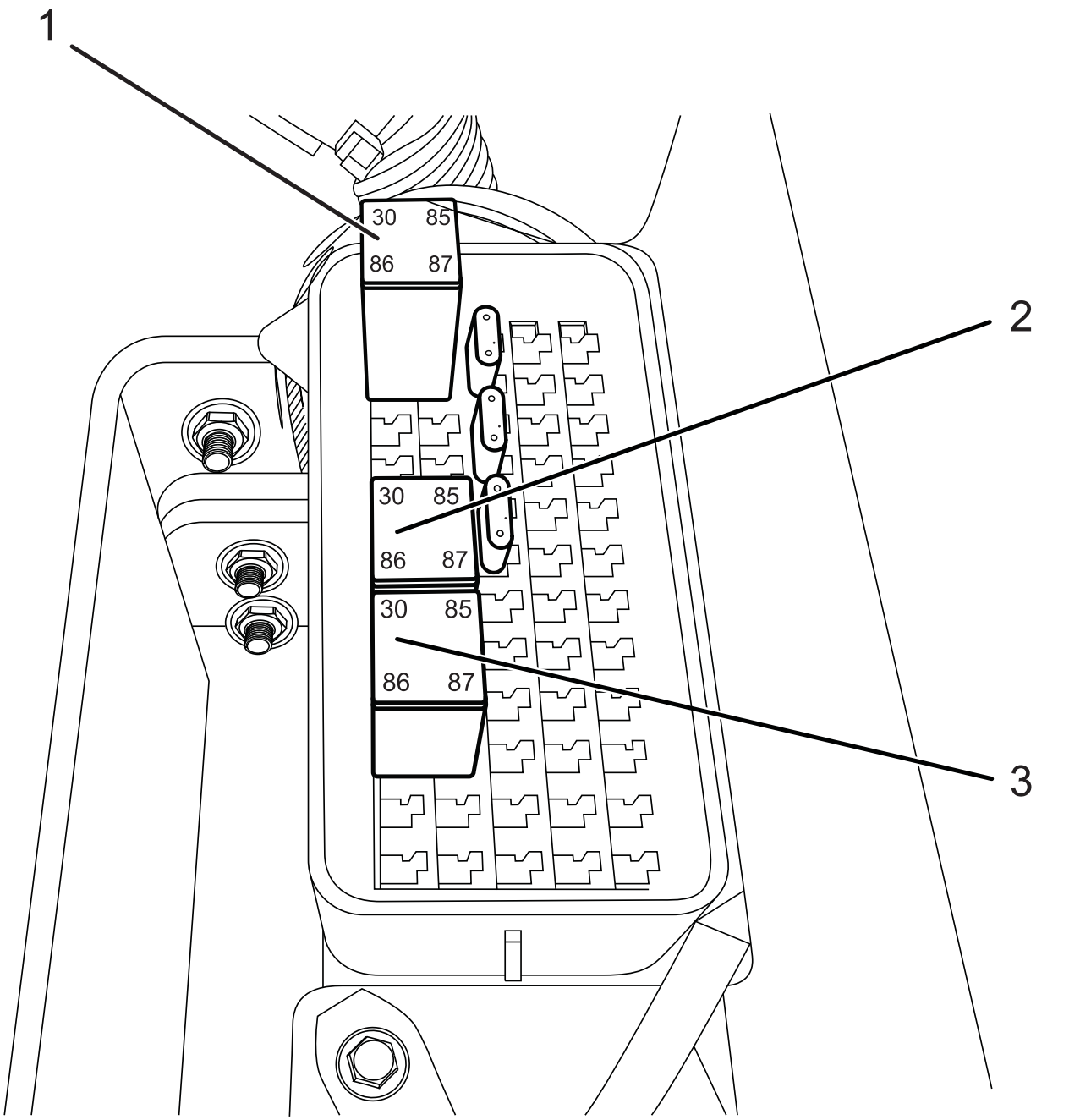


Figure 189 DEF: LHR Location

1. DEF: LHR
2. DEF: SMH Relay
3. Switched ignition relay

Step 1	Inspect connections at Power Distribution Module (PDM).	Decision
A. Key OFF. B. Check PDM, fuses, and relays for blown fuses and loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?		Yes: Go to Step 2. No: Repair PDM, fuses, and / or relays. After repairs are complete, retest for SPN 5491 FMI 3.

Step 2	Inspect connections at ACM.	Decision
A. Key OFF. B. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5491 FMI 3.

Pin-Point Tests (SPN 5491 FMI 3)

DEF Line Heater Relay Circuit

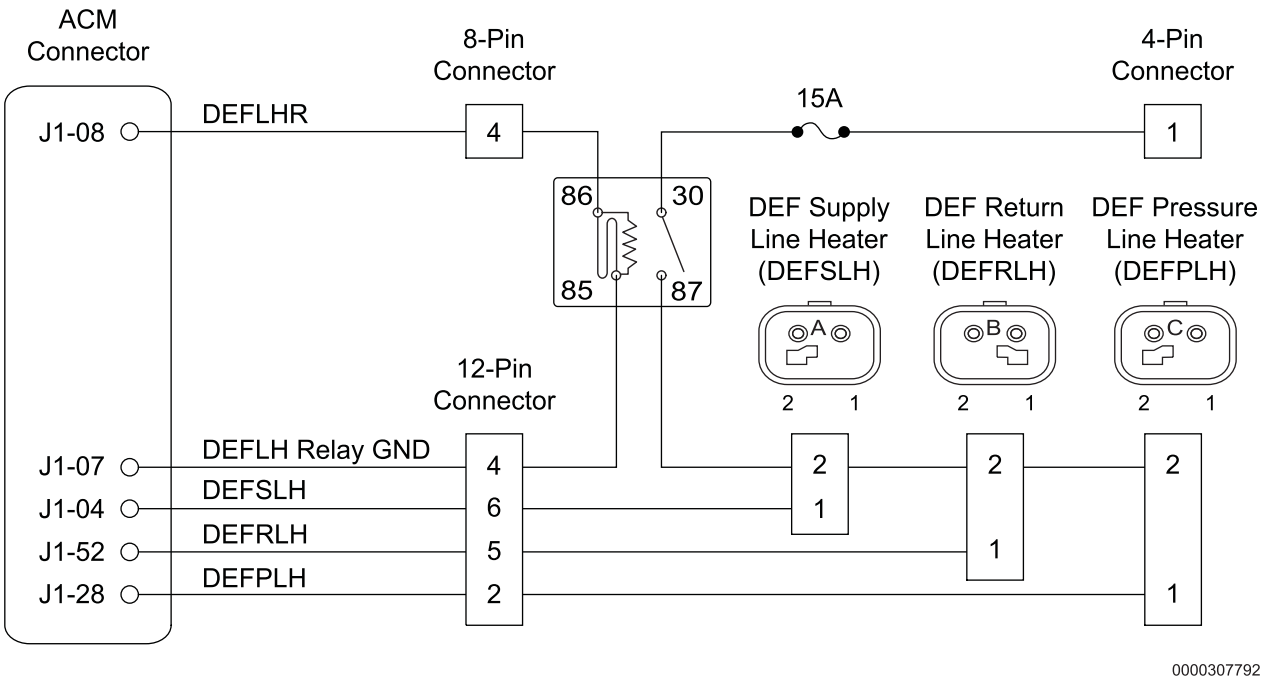
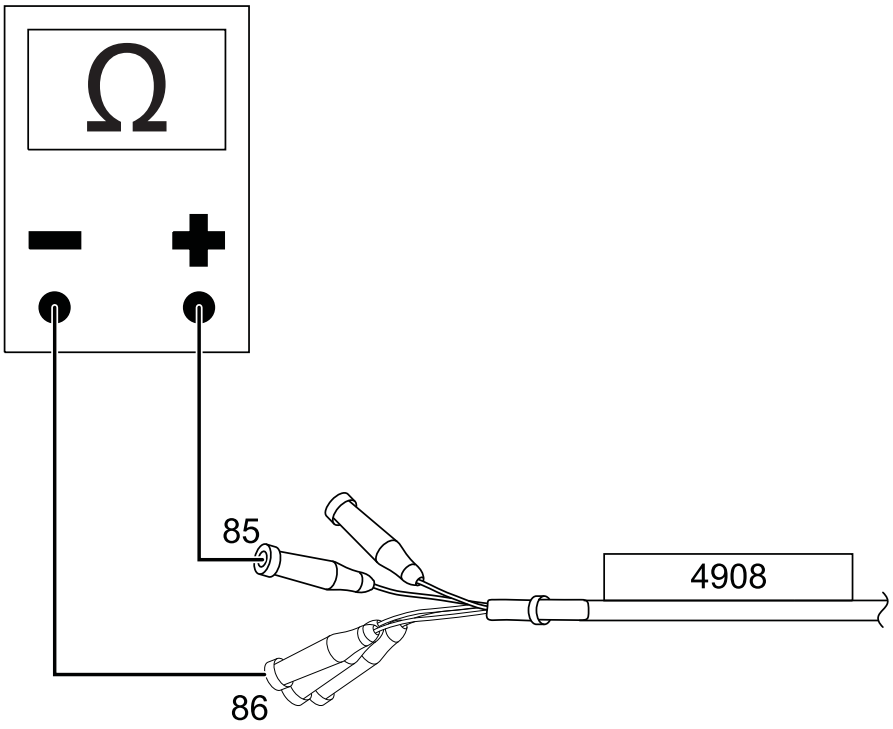


Figure 190 DEF: LHR Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- ACM Breakout Box Overlay 18-537-01-02
- Breakout Harness ZTSE4908
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)



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Figure 191 Test 1 DEF: LHR Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Remove DEF: LHR from PDM and install it into Breakout Harness ZTSE4908. Leave Breakout Harness ZTSE4908 disconnected from PDM.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Between 100 and 300 ohms
Decision	
Is resistance between 100 and 300 ohms?	Yes: Go to Test 2.
	No: Replace DEF: LHR. After repairs are complete, retest for SPN 5491 FMI 3.

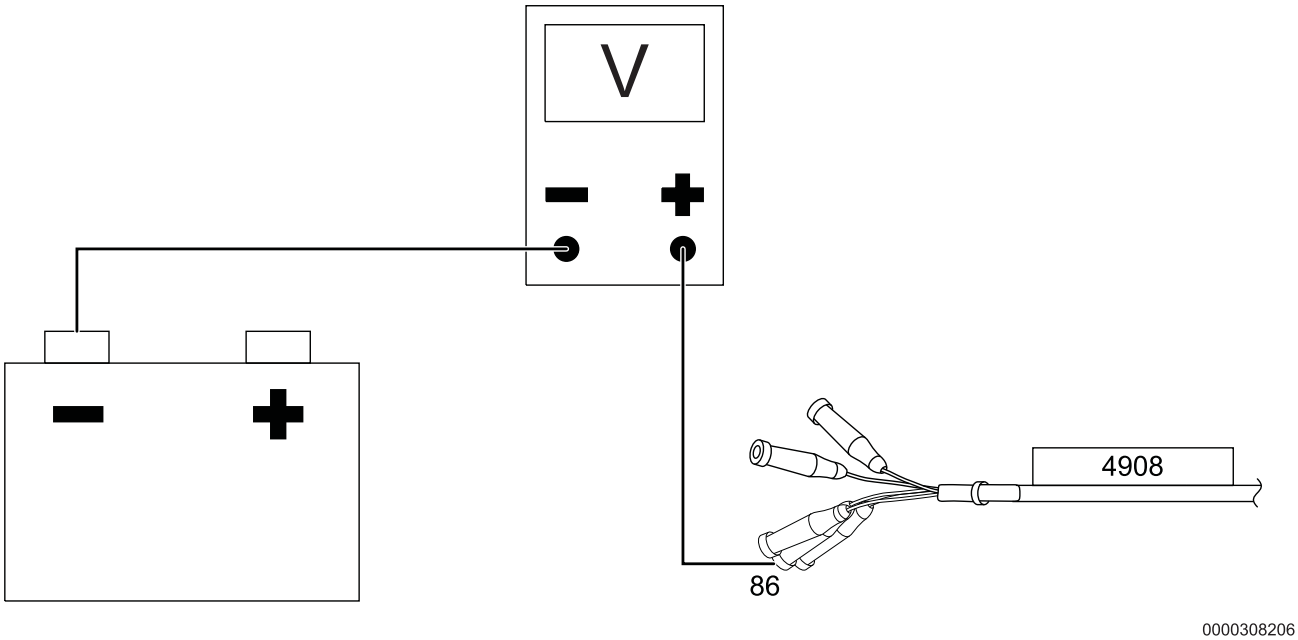


Figure 192 Test 2 DEF: LHR Circuit Voltage Check

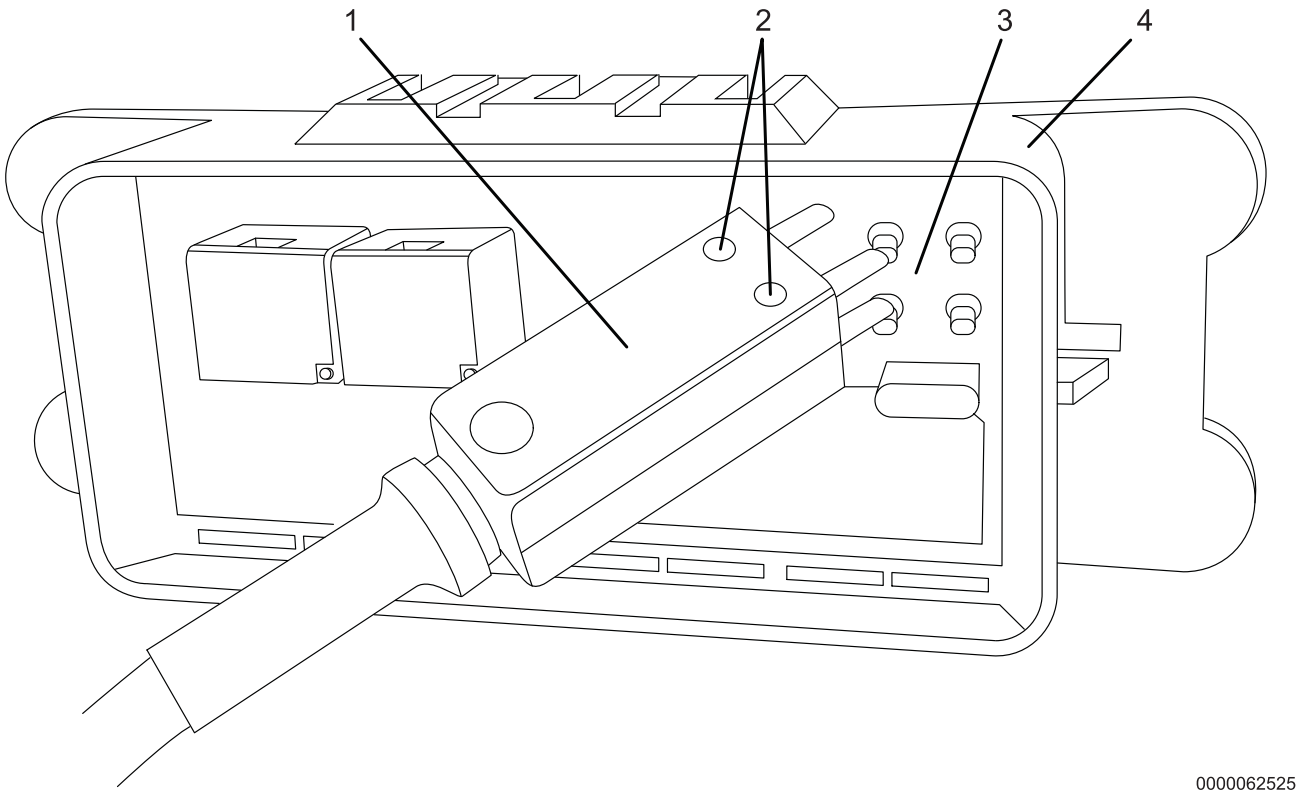


Figure 193 Installation of Breakout Harness ZTSE4908

1. Breakout Harness ZTSE4908
2. Installation dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF. B. Install Breakout Harness ZTSE4908 into PDM and leave relay disconnected. C. Disconnect ACM connector J1 and leave connector disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-86 and known good ground.	Less than 0.5 volt
Decision	
Is voltage less than 0.5 volt?	Yes: Go to Test 3.
	No: Repair short to PWR between DEF: LHR pin-86 and ACM connector pin J1-08. After repairs are complete, retest for SPN 5491 FMI 3.

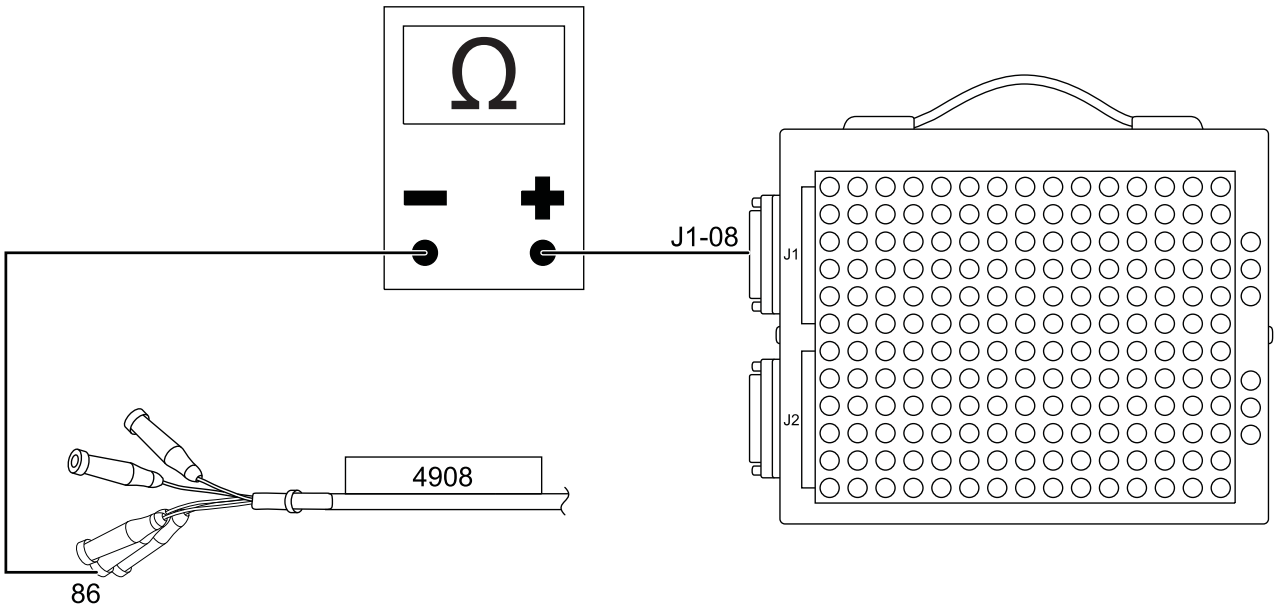


Figure 194 Test 3 DEF: LHR Circuit Resistance Check

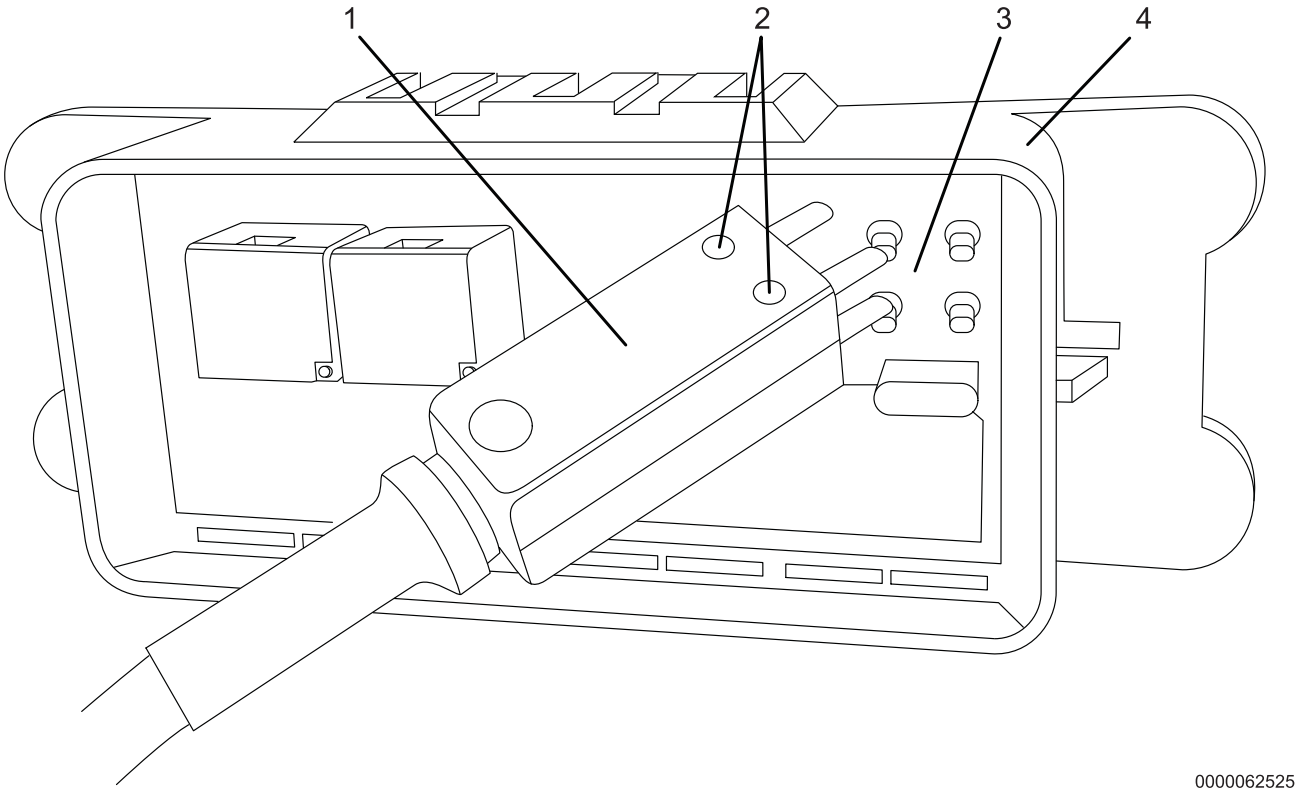


Figure 195 Installation of Breakout Harness ZTSE4908

1. Breakout Harness ZTSE4908
2. Installation dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-537-01 to vehicle harness and leave ACM disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box 00-00956-08. D. Install Breakout Harness ZTSE4908 into PDM, and leave relay disconnected.

Test 3	Specification
Use DMM to measure resistance between 180-pin Breakout Box pin J1-08 and Breakout Harness ZTSE4908 pin-86.	Less than 0.5 ohms.
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open or high resistance between DEF: LHR pin-85 and ACM connector pin J1-07. After repairs are complete, retest for SPN 5491 FMI 3.
	No: Repair Open or high resistance between DEF: LHR pin-86 and ACM pin J1-08. After repairs are complete, retest for SPN 5491 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5491 FMI 3 fault code diagnostics.

SPN 5491 FMI 4 - DEF Line Heater Relay short to GND

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Line Heater Relay (DEF: LHR) voltage below normal or shorted to ground.	Resistance between DEF: LHR control and ground is < 0.2 ohms.	Key ON DEF: LHR is ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects signal voltage from Diesel Exhaust Fluid Line Heater Relay (DEF: LHR) is lower than expected for 3 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: LHR short to GND
- Failed DEF: LHR

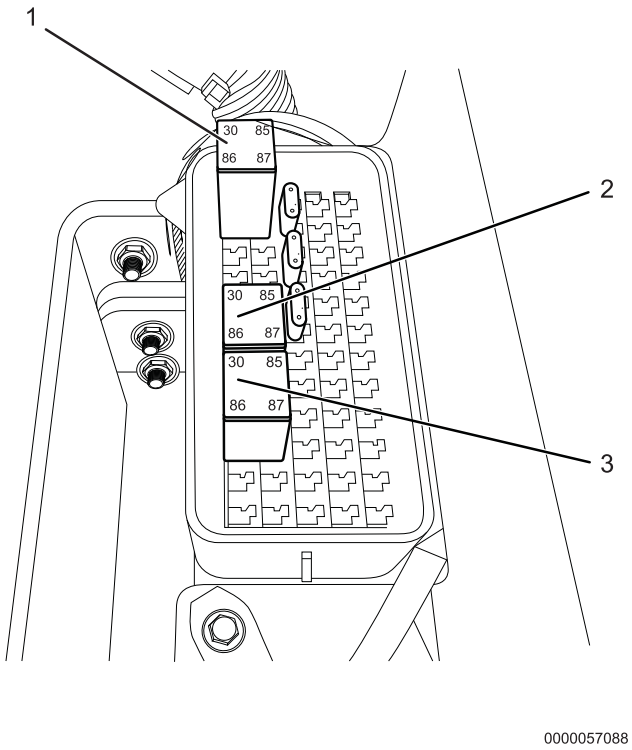


Figure 196 DEF: LHR Location

1. DEF: LHR
2. DEF Supply Module Heater (DEF: SMH) Relay
3. Switched Ignition Relay

Step 1	Inspect connections at Power Distribution Module (PDM).	Decision
A. Key OFF. B. Check PDM, fuses, and relays for blown fuses and loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?		Yes: Perform Pin-Point Tests. No: Repair PDM, fuses, and / or relays. After repairs are complete, retest for SPN 5491 FMI 4.

Pin-Point Tests (SPN 5491 FMI 4)

DEF Line Heater Relay Circuit

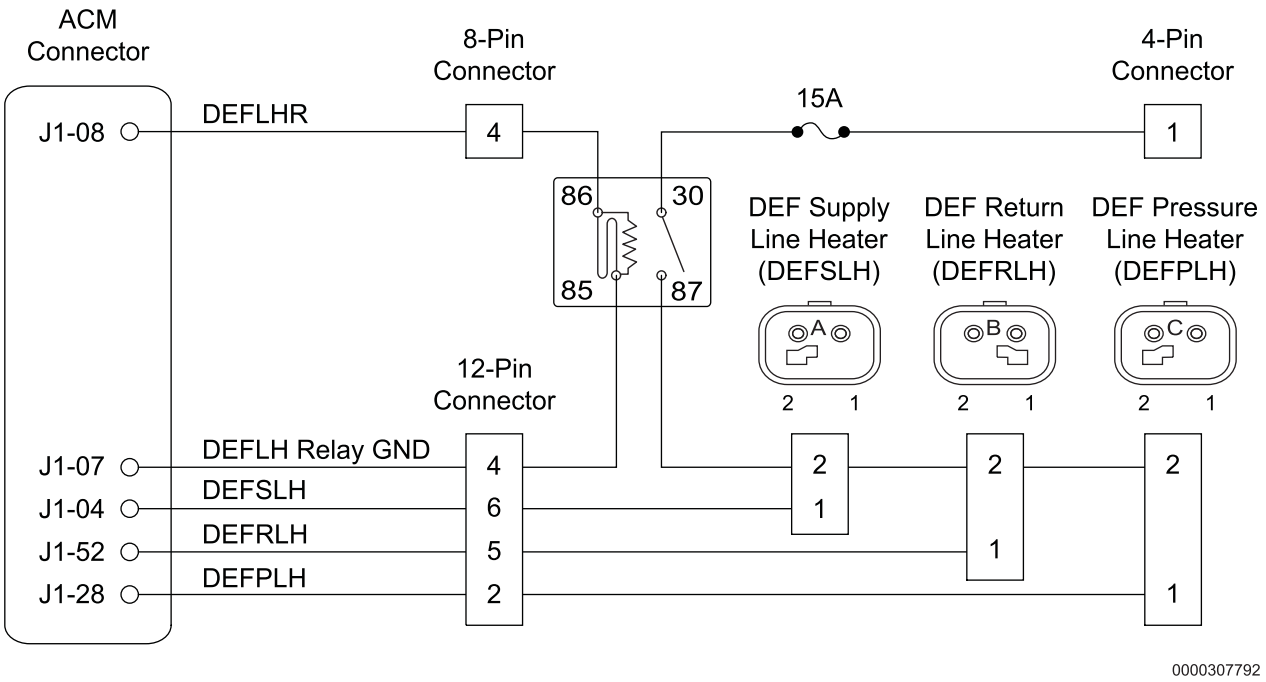
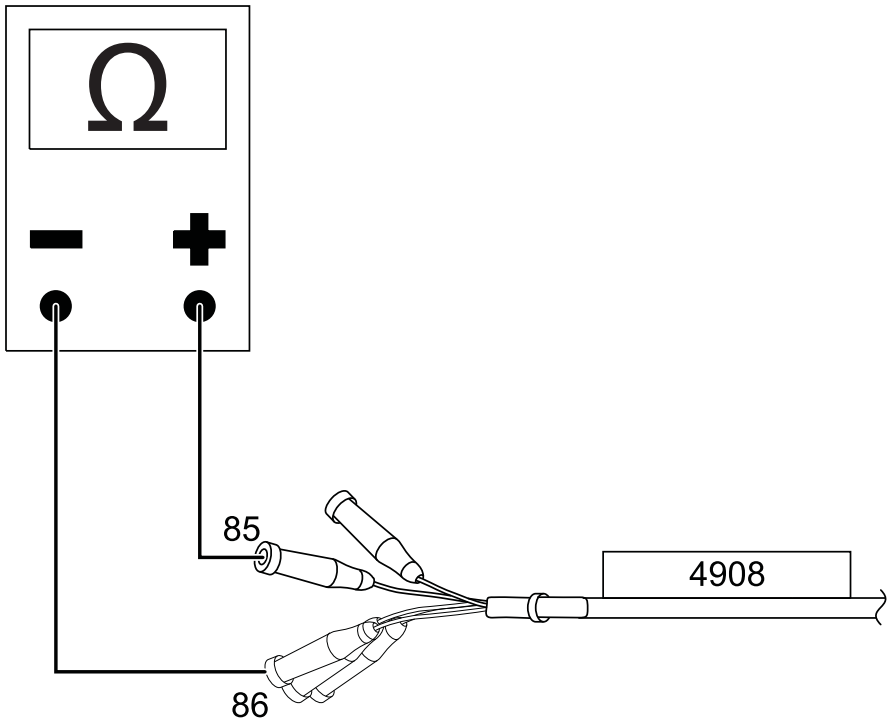


Figure 197 DEF: LHR Circuit

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)



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Figure 198 Test 1 DEF: LHR Resistance Check

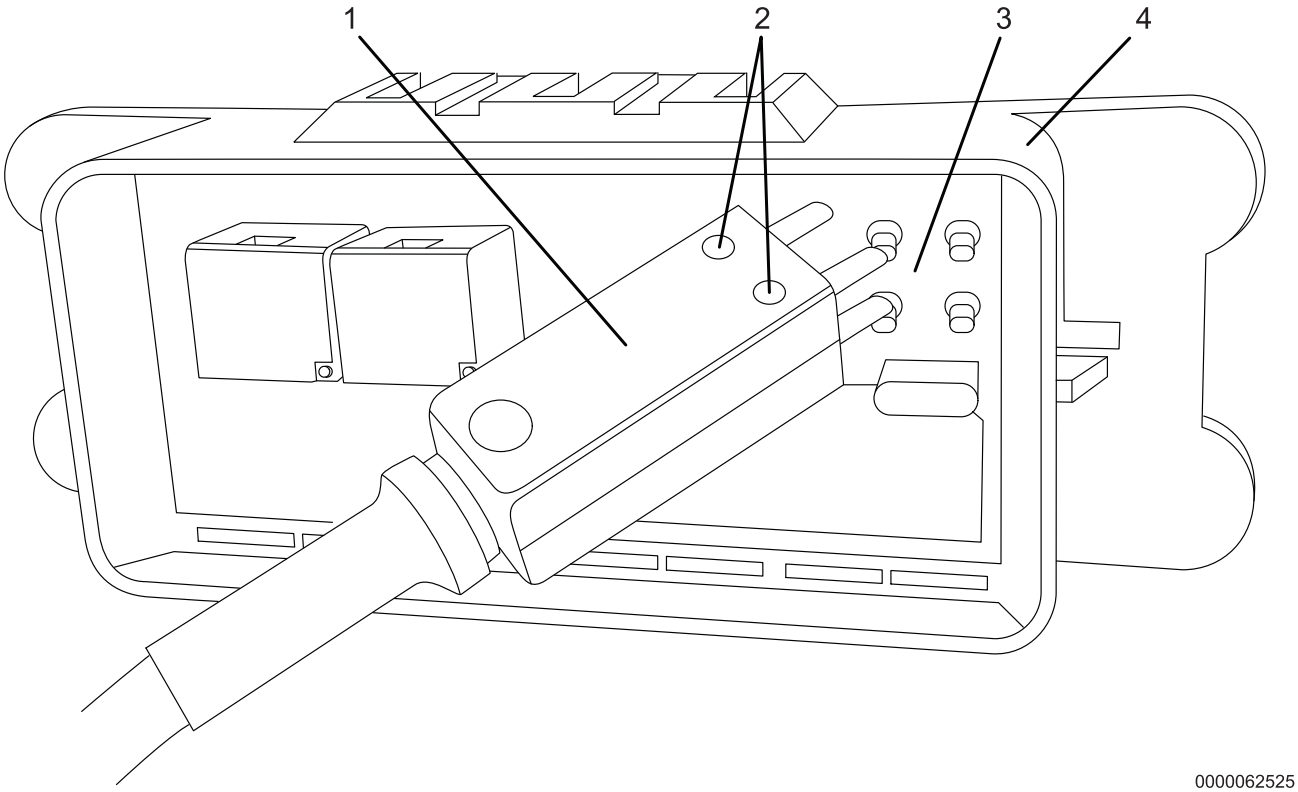


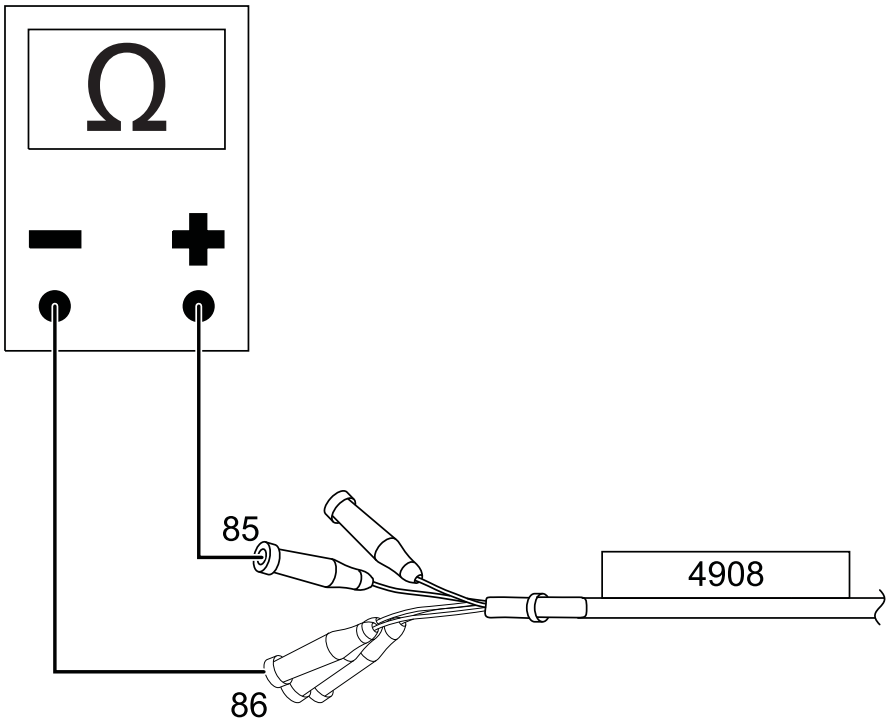
Figure 199 Installation of Breakout Harness ZTSE4908

1. Breakout Harness ZTSE4908
2. Installation dimples
3. Relay socket
4. PDM

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 1 Setup
A. Key OFF. B. Remove DEF: LHR from PDM and install it into Breakout Harness ZTSE4908. Leave Breakout Harness ZTSE4908 disconnected from PDM.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Between 100 and 300 ohms.
Decision	
Is resistance between 100 and 300 ohms?	Yes: Go to Test 2.
	No: Replace DEF: LHR. After repairs are complete, retest for SPN 5491 FMI 4.



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Figure 200 Test 2 DEF: LHR Resistance Check

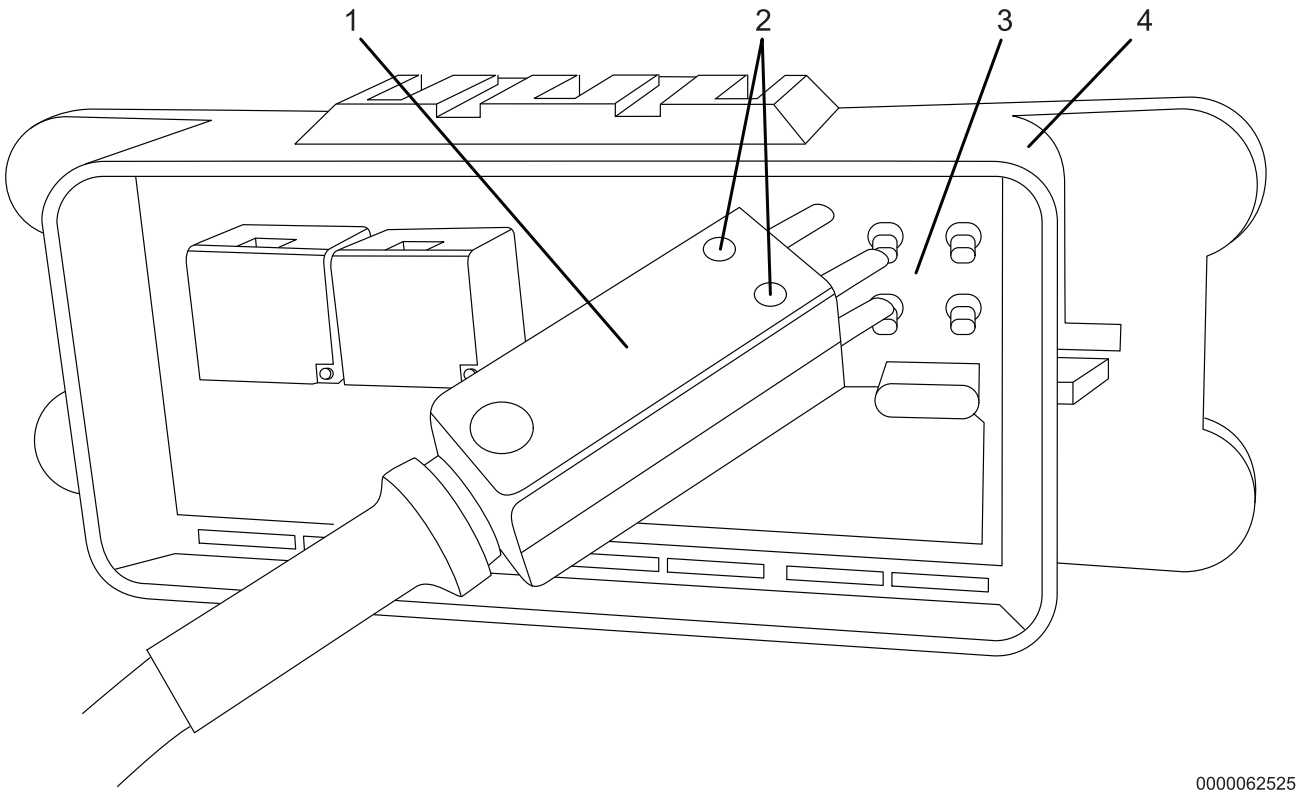


Figure 201 Installation of Breakout Harness ZTSE4908

1. Breakout Harness ZTSE4908
2. Installation dimples
3. Relay socket
4. Power Distribution Module (PDM)

For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF. B. Install Breakout Harness ZTSE4908 into PDM and leave relay disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Less than 100 ohms.
Decision	
Is resistance less than 100 ohms?	Yes: Repair short between ACM pin J1-08 and ACM pin J1-07. After repairs are complete, retest for SPN 5491 FMI 4.
	No: Repair short to GND between DEF: LHR pin-86 and ACM pin J1-08. After repairs are complete, retest for SPN 5491 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5491 FMI 4 fault code diagnostics.

DEF: AP (Diesel Exhaust Fluid Absolute Pressure)

Overview of DEF: AP Sensor Group

SPN	FMI	Description
4334	2	DEFLP signal erratic, intermittent or incorrect (page 593)
4334	3	DEFAP signal Out of Range HIGH (page 596)
4334	4	DEFAP signal Out of Range LOW (page 602)
4334	16	DEF Absolute Pressure above maximum (page 608)
4334	18	DEF Absolute Pressure below normal (page 610)
4337	2	DEF Dosing Unit Temperature - Data Erratic, Intermittent, or Incorrect (page 614)
4337	10	DEF Dosing Unit Temperature abnormal rate of change (page 621)

Overview

Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor measures Diesel Exhaust Fluid (DEF) pressure from DEF Supply Pump (DEF: SP). When DEF pressure is high, signal from DEF: AP sensor is high. DEF: AP sensor is located within the DEF Supply Module and is a non-serviceable component.

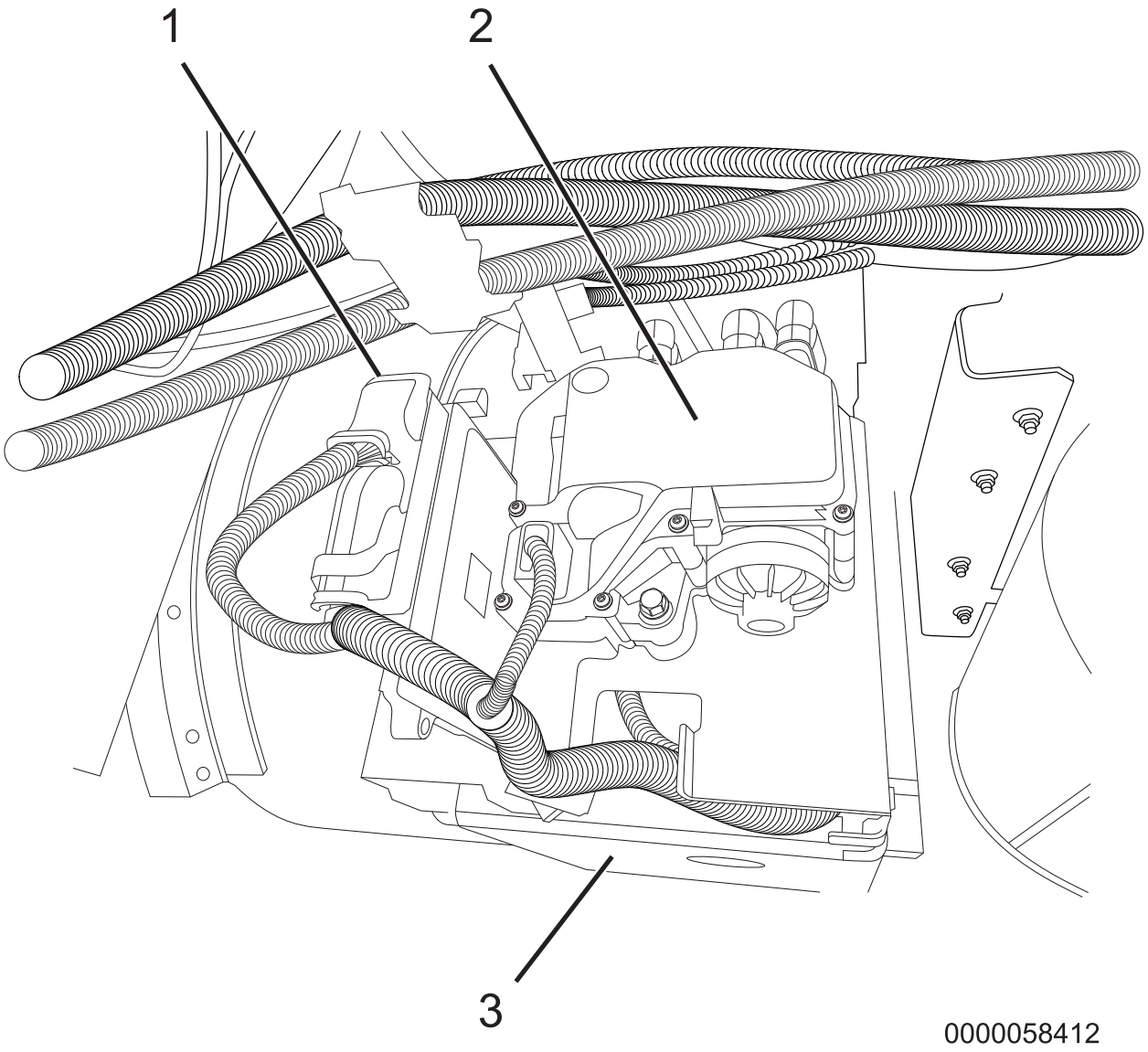


Figure 202 DEF: AP Sensor Location

1. Aftertreatment Control Module (ACM)
2. DEF supply module
3. DEF tank

SPN 4334 FMI 2 - DEFLP signal erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor signal is erratic, intermittent, or incorrect.	Diesel Exhaust Fluid (DEF) supply module pump pressure measured after priming > 160 psi (1,100 kPa) (gauge) or DEF supply module pump pressure < 102 psi (700 kPa) (gauge) OR DEF supply module pump pressure measured at start of priming > 7 psi (50 kPa) (gauge) OR DEF supply module pump pressure < -7 psi (-50 kPa) (gauge)	DEF supply module filled with DEF pressure > 29 psi (200 kPa) DEF tank has been defrosted DEF supply line has been defrosted DEF supply module has been defrosted, or DEF supply module defrost is not required Engine Running Inactive: SPN 3361 FMI 3 and 4 (DEF: SP); SPN 4334 FMI 3 and 4 (DEF: AP); SPN 4376 FMI 3 and 4 (DEF: RCV)

Fault Overview

Fault code sets when Diesel Exhaust Fluid (DEF) supply module is unable to maintain commanded DEF pressure. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 4334 FMI 3 and 4 (DEF: AP)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Debris in DEF tank / restricted DEF tank screen
- DEF tank, supply module, or doser unit line or connection loose, leaking, or damaged
- Restricted DEF suction, pressure, or return line
- Restricted DEF supply module filter
- Failed DEF supply module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with Service Maxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 593). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4334 FMI 2.

Step 2	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4334 FMI 2.

Step 3	Inspect DEF tank.	Decision
A. Key OFF. B. Check DEF tank for debris or foreign particles. Also check DEF tank vent for restrictions or fluid crystallization. Are DEF tank and DEF tank vent clean and free of debris, restrictions, and fluid crystallization?		Yes: Go to Step 4. No: Drain DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4334 FMI 2.

Step 4	Inspect connections at Diesel Exhaust Fluid Doser Unit (DEF: DU) lines.	Decision
A. Key OFF. B. Disconnect DEF: DU. C. Check DEF tank, DEF supply module, and DEF: DU lines and connections for: cracks and pitting; loose, leaking, or damaged connections. Are DEF tank, DEF supply module, and DEF: DU lines and connections in good condition, not cracked, leaking, or damaged?		Yes: Go to Step 5. No: Repair or replace failed line or connection. After repairs are complete retest for SPN 4334 FMI 2.

Step 5	Inspect DEF supply module.	Decision
A. Key OFF. B. Unscrew DEF supply module filter cap, and remove filter from supply module. C. Check DEF supply module filter for restrictions and debris. Is DEF supply module filter free of debris and restrictions?		Yes: Go to Step 6. No: Replace DEF supply module filter and clean DEF supply module. After repairs are complete, retest for SPN 4334 FMI 2.

Step 6	Check for failed DEF: AP sensor.	Decision
A. Key OFF. B. Disconnect DEF supply module pressure line at DEF: DU and place appropriate container under vehicle to catch DEF. C. Key-On Engine-Off (KOEO). D. Using EST with ServiceMaxx™ software, load signals session and monitor DEF: AP signal. Is DEF: AP signal within 10 psi of 0 psi?		Yes: Go to Step 7. No: Replace the DEF supply module. After repairs are complete, retest for SPN 4334 FMI 2.

Step 7	Inspect DEF supply line.	Decision
A. Key OFF. B. Disconnect both ends of supply line and blow compressed air through line. Does compressed air flow freely through supply line?		Yes: Go to Step 8. No: Clean or replace DEF supply module supply line. After repairs are complete, retest for SPN 4334 FMI 2.

Step 8	Inspect DEF supply module return line.	Decision
A. Key OFF. B. Disconnect both ends of return line and blow compressed air through line. Does compressed air flow freely through return line?		Yes: Go to Step 9. No: Clean or replace DEF supply module return line. After repairs are complete, retest for SPN 4334 FMI 2.

Step 9	Inspect DEF supply module pressure line.	Decision
A. Key OFF. B. Disconnect both ends of pressure line and blow compressed air through line. Does compressed air flow freely through pressure line?		Yes: Retest for SPN 4334 FMI 2. No: Clean or replace DEF supply module pressure line. After repairs are complete, retest for SPN 4334 FMI 2.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4334 FMI 2 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4334 FMI 3 - DEFAP Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor signal is high.	DEF: AP > 4.75 volts [189 psi (1,300 kPa gauge)]	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects signal from DEF: AP sensor is greater than 4.75 volts for 8 seconds. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3512 FMI 14 (VREF 4)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: AP signal circuit short to PWR
- SIG GND circuit Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 596). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 3.

Step 2	Check for active fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 4334 FMI 3. Does EST DTC list show SPN 4334 FMI 3 as active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 3.

Pin-Point Tests (SPN 4334 FMI 3)

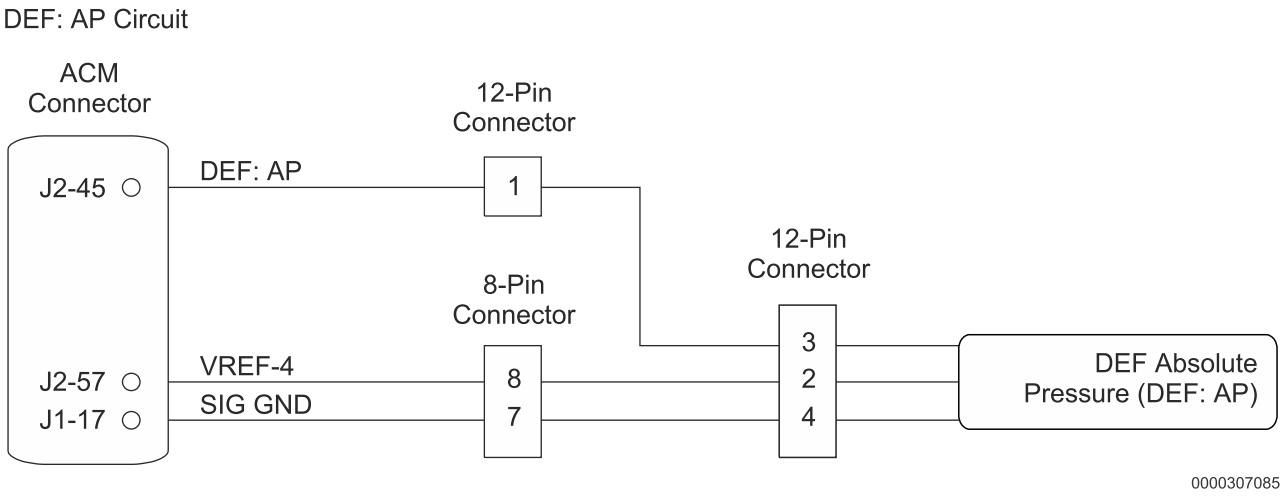


Figure 203 DEF: AP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

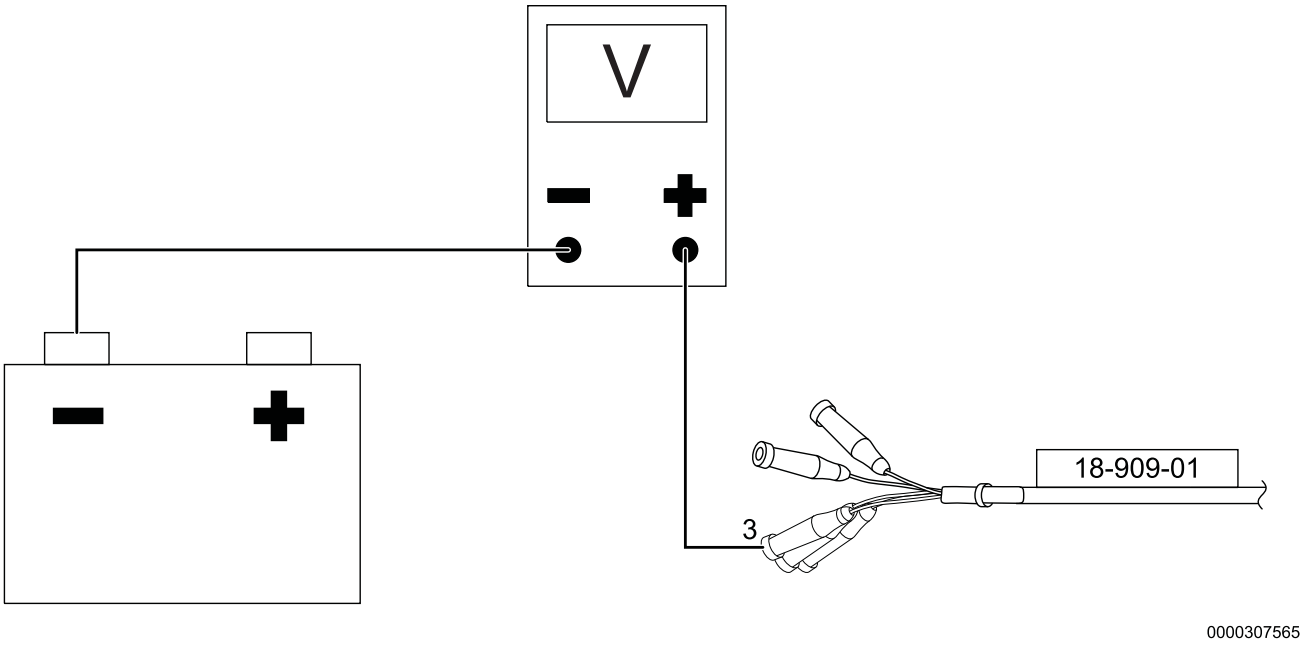


Figure 204 Test 1 DEF: AP Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 between DEF supply module and vehicle harness connector. C. Key ON.

Test 1	Specification
Using DMM, measure voltage between Breakout Harness 18-909-01 pin-3 and known good ground.	Less than 4.75 volts
Decision	
Is voltage less than 4.75 volts?	Yes: Go to Test 2
	No: Repair short to PWR between DEF supply module connector pin-3 and ACM connector pin J2-45. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 3.

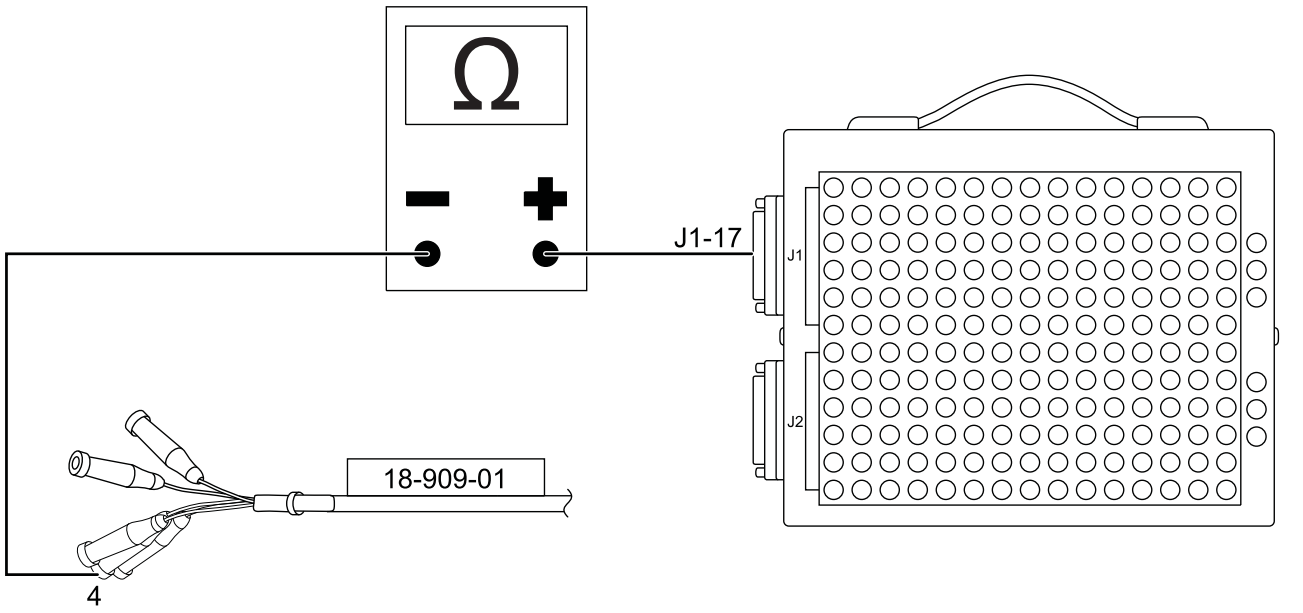


Figure 205 Test 2 DEF: AP Sensor Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect Breakout Harness 18-537-01 (96-pin) with 180-pin Breakout Box to ACM vehicle harness connector and leave ACM disconnected.

Test 2	Specification
Use DMM, to measure resistance between Breakout Harness 18-909-01 pin-4 and 180-pin Breakout Box pin J1-17.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 3.
	No: Repair Open or high resistance between DEF supply module pin-4 and ACM connector pin J1-17. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4334 FMI 3 fault code diagnostics.

SPN 4334 FMI 4 - DEFAP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor signal is low.	DEF: AP < 0.25 volts [15 psi (100 kPa gauge)]	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects signal from Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor is less than 0.25 volts for 8 seconds. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3512 FMI 14 (VREF 4)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: AP signal circuit short to GND
- SIG GND Circuit Open or high resistance
- VREF 4 circuit Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 602). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.

Step 2	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.

Pin-Point Tests (SPN 4334 FMI 4)

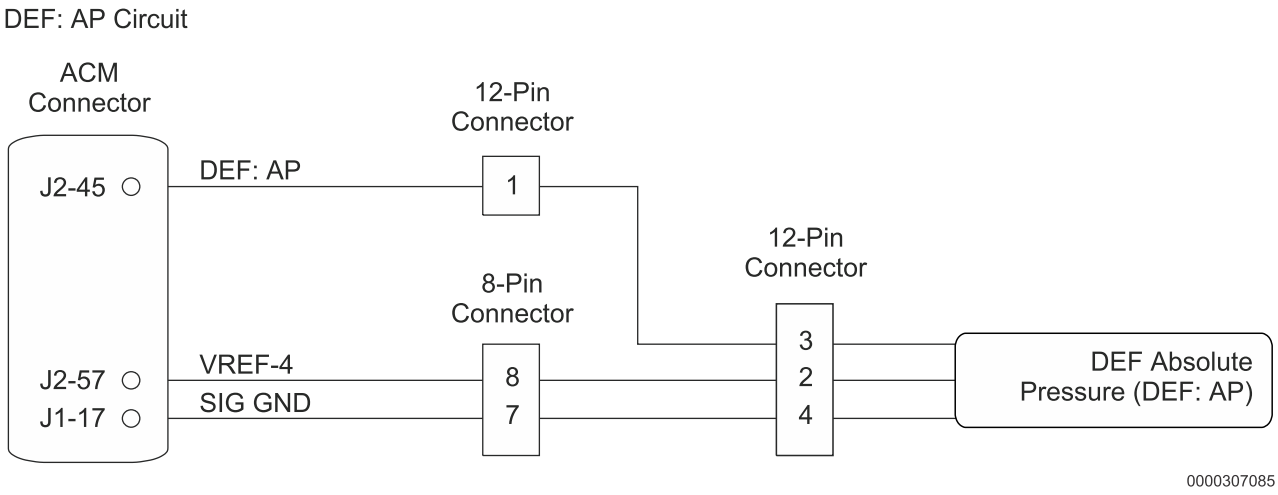


Figure 206 DEF: AP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

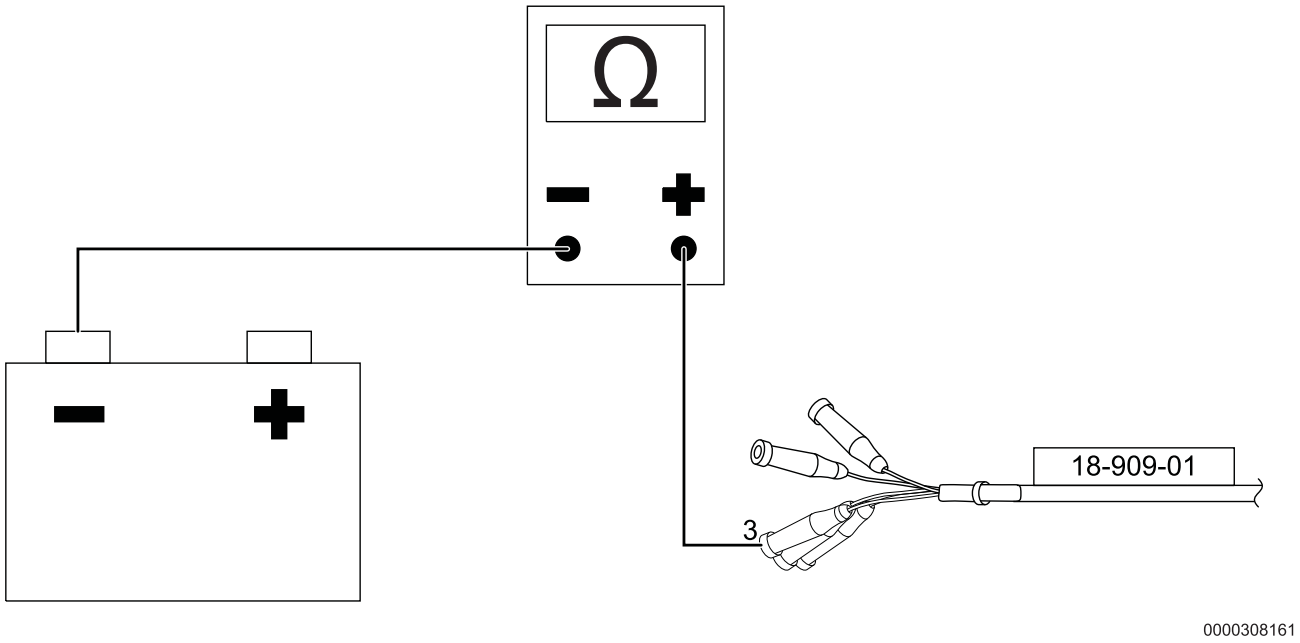


Figure 207 Test 1 DEF: AP Sensor Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-3 and known good GND.	Greater than 1000 ohms.
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to GND between DEF supply module connector pin-3 and ACM connector pin J2-45. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.

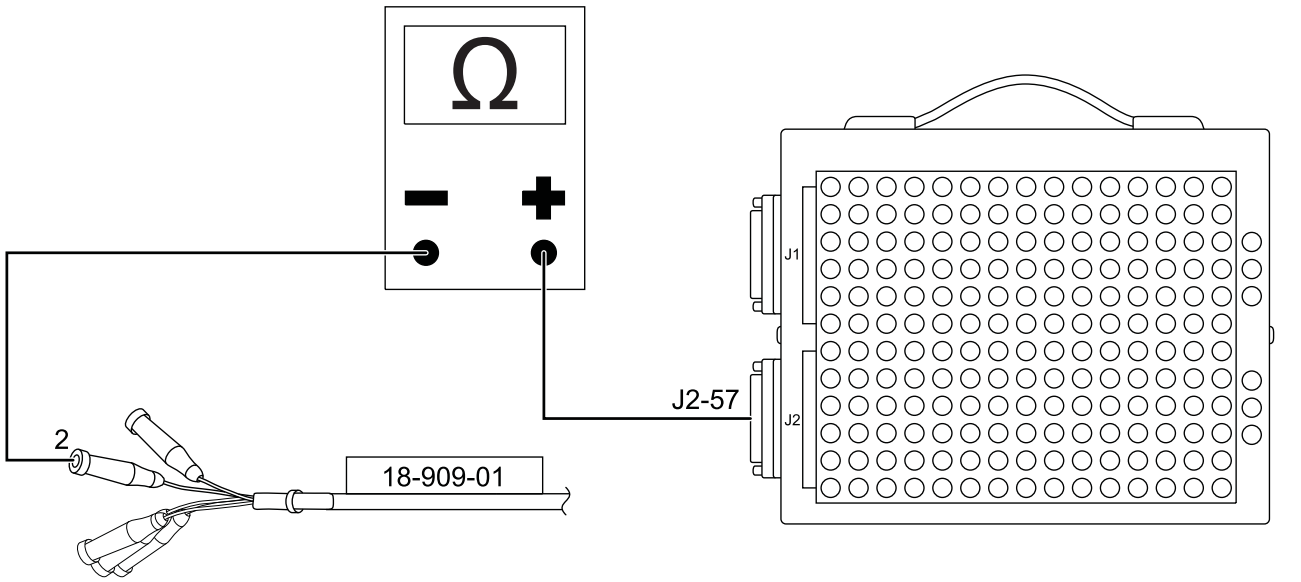


Figure 208 Test 2 DEF: AP Sensor Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-2 and 180-pin Breakout Box pin J2-57.	Less than 5 ohms.
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3.
	No: Repair Open or high resistance between DEF supply module connector pin-2 and ACM connector pin J2-57. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.

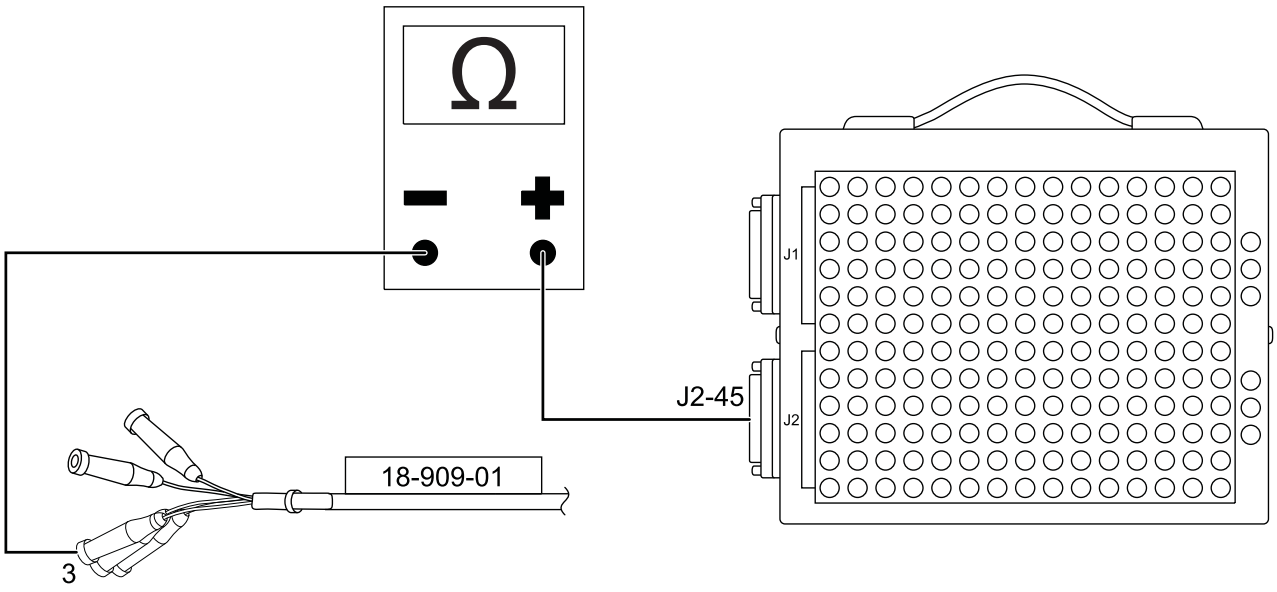


Figure 209 Test 3 DEF: AP Sensor Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-3 and 180-pin Breakout Box pin J2-45.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.
	No: Repair Open or high resistance between DEF supply module connector pin-3 and ACM connector pin J2-45. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4334 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4334 FMI 4 fault code diagnostics.

SPN 4334 FMI 16 - DEF Absolute Pressure above maximum

Condition / Description	Setting Criteria	Enable Conditions / Values
Blockage in the Diesel Exhaust Fluid (DEF) supply module return line has been detected.	DEF: AP > 160 psi (1,100 kPa) (gauge)	Key ON DEF supply module defrost not required or DEF supply module defrost is completed. The following fault codes must be inactive: SPN 3361 FMI 3 and 4 (DEF: SP); SPN 4334 FMI 2, 3, and 4 (DEF: AP)

Fault Overview

Fault code sets when Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor detects pressure in Diesel Exhaust Fluid (DEF) supply module is above 160 psi (1100 kPa) for more than 20 seconds. Engine torque will be reduced if fault is active for a limited period of time. Engine torque will be severely reduced, and vehicle speed limited if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1761 (DEF: TL)	• SPN 3031 (DEF: TT)	• SPN 3361 (DEF: SP)	• SPN 3362 (DEF: SP)
• SPN 3363 FMI (DEF: THC)	• SPN 4376 (DEF: RCV)	• SPN 5394 (DEF: DU)	• SPN 5491 (DEF: L2HC)
• SPN 5745 (DEF: SMH)	• SPN 5746 (DEF: SMH Relay)	• SPN 5798 (DEF: SMH)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEF supply module
- Restricted DEF return line

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 608). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4334 FMI 16.

Step 2	Inspect connections at DEF supply module	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4334 FMI 16.

Step 3	Check DEF supply module return line for restrictions.	Decision
Disconnect both ends of return line and blow compressed air through line. Does compressed air flow freely through return line?		Yes: Clean DEF supply module using DEF Doser Cleaning Kit - 18-200-01 and perform drive cycle 27. If SPN 4334 FMI 16 is still active, replace DEF supply module. After repairs are complete, retest for SPN 4334 FMI 16. No: Clean or replace DEF supply module return line. After repairs are complete, retest for SPN 4334 FMI 16.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4334 FMI 16 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4334 FMI 18 - DEF Absolute Pressure below normal

Condition / Description	Setting Criteria	Enable Conditions / Values
Low Diesel Exhaust Fluid Absolute Pressure (DEF: AP) signal.	DEF: AP < 102 psi (700 kPa) (gauge)	DEF tank has been defrosted DEF supply module has been filled with DEF fluid DEF supply module suction line has been defrosted DEF supply module has been defrosted Key-On Engine-Running (KOER) The following fault codes must be inactive: SPN 3361 FMI 3 and 4 (DEF: SP); SPN 4334 FMI 2, 3, and 4 (DEF: AP)

Fault Overview

Fault code sets when Diesel Exhaust Fluid Absolute Pressure (DEF: AP) sensor detects Diesel Exhaust Fluid supply module is unable to build or maintain adequate pressure. Engine torque will be reduced if fault is active for a limited period of time. Engine torque will be severely reduced, and vehicle speed limited if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1761 (DEF: TL)	• SPN 3031 (DEF: TT)	• SPN 3361 (DEF: SP)	• SPN 3362 (DEF: SP)
• SPN 3363 FMI (DEF: THC)	• SPN 4376 (DEF: RCV)	• SPN 5394 (DEF: DU)	• SPN 5491 (DEF: L2HC)
• SPN 5745 (DEF: SMH)	• SPN 5746 (DEF: SMH Relay)	• SPN 5798 (DEF: SMH)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Debris in DEF tank / restricted DEF tank screen
- DEF tank, supply module, or doser unit line or connection loose, leaking, or damaged
- Failed DEF supply module
- Low DEF tank level
- Restricted DEF suction line

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 610). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4334 FMI 18.

Step 2	Check DEF tank level.	Decision
Read DEF level using the vehicle instrument panel gauge and perform a visual inspection of fluid level in the DEF tank. Is DEF tank fluid level below 1/2 tank?		Yes: Fill DEF tank with appropriate DEF. After repairs are complete, retest for SPN 4334 FMI 18. No: Go to Step 3.

Step 3	Check DEF tank and vent.	Decision
A. Check DEF tank for debris or foreign particles. B. Check DEF tank vent for restrictions or fluid crystallization. Are DEF tank and DEF tank vent clean and free of debris, restrictions, and fluid crystallization?		Yes: Go to Step 4. No: Drain DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4334 FMI 18.

Step 4	Check DEF tank, DEF supply module, and DEF Doser Unit (DEF: DU) lines and connections.	Decision
Check DEF tank, DEF supply module, and DEF: DU lines and connections for: cracks and pitting; loose, leaking, or damaged connections. Are the DEF tank, DEF supply module: and DEF: DU lines and connections in good condition, and free of cracks; leaks; and damage?		Yes: Go to Step 5. No: Repair or replace failed line or connection. After repairs are complete retest for SPN 4334 FMI 18.

Step 5	Check DEF supply module suction line for restrictions.	Decision
Disconnect both ends of suction line and blow compressed air through line. Does compressed air flow freely through suction line?		Yes: Go to Step 6. No: Clean or replace DEF supply module suction line. After repairs are complete, retest for SPN 4334 FMI 18.

Step 6	Check DEF tank fluid pickup screen for restrictions.	Decision
Remove DEF tank pickup assembly (see *Exhaust Aftertreatment System with DPF and SCR Service Manual*). Inspect DEF tank fluid pickup screen for restrictions or buildup. Is DEF tank fluid pickup screen free of restrictions?		Yes: Replace DEF supply module. After repairs are complete, retest for SPN 4334 FMI 18.
		No: Clean or replace DEF tank fluid pickup screen. Drain, clean, and fill the DEF tank. Clean DEF supply module using DEF Doser Cleaning Kit - 18-200-01. After repairs are complete, retest for SPN 4334 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4334 FMI 18 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4337 FMI 2 - DEF Dosing Unit Temperature - Data Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) supply module temperature is in range but not rational	Difference between DEF supply module temperature at Key ON and Intake Air Temperature (IAT) at Key ON > 72°F (40°C) Difference between DEF supply module temperature at Key ON and coolant temperature at Key ON > 72°F (40°C)	Engine is cold soaked 10 hours Block heater not detected Valid DEF supply module temperature value is available Valid DEF Dosing Supply Module Heater (DEF: SMH) temperature value is available Diagnostic has not previously completed during this key cycle Following fault code must be inactive: SPN 3361 FMI 2 (DEF: SP)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid (DEF) supply module temperature differs from engine coolant temperature and Intake Air Temperature (IAT) by more than 72°F (40°C) at Key ON.

Lamp Reaction

Malfunction Indicator Lamp (MIL)will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 110 FMI 2, 3, and 4 (ECT1)	• SPN 172 FMI 2, 3, and 4 (IAT)	• SPN 3361 FMI 2, 3, and 4 (DEF: SP)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Diesel Exhaust Fluid Supply Pump (DEF: SP) Temperature / CTL circuit intermittent short to GND
- DEF: SP Temp / CTL circuit intermittent short to PWR
- DEF: SP Temp / CTL circuit intermittent Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 614). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4337 FMI 2.

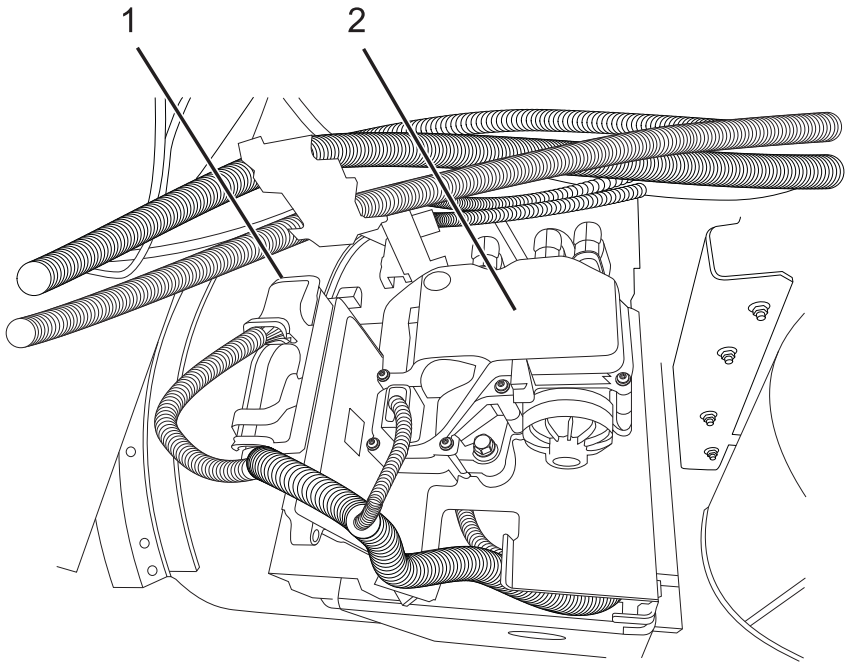


Figure 210 DEF Supply Module Location (typical)

1. ACM
2. DEF supply module

Step 2	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connectors. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connectors, harnesses, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4337 FMI 2.

Step 3	Inspect connections at ACM.	Decision
A. Key OFF. B. Disconnect ACM connectors. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4337 FMI 2.

Pin-Point Tests (SPN 4337 FMI 2)

DEF: SP and Temperature Sensor Circuit

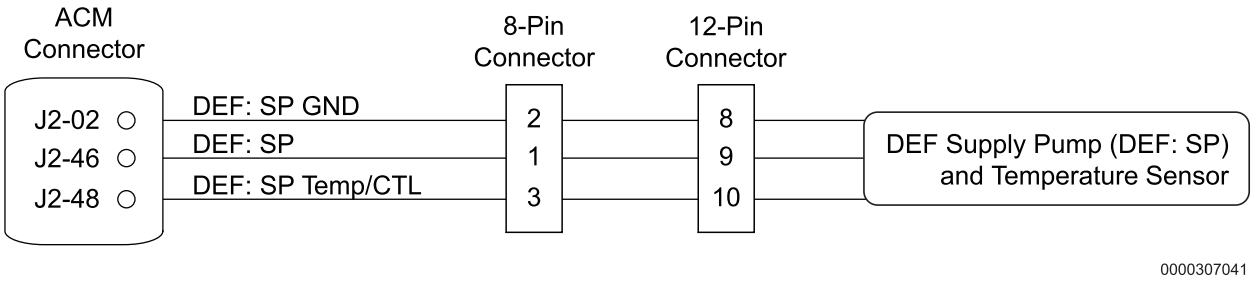


Figure 211 DEF: SP Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

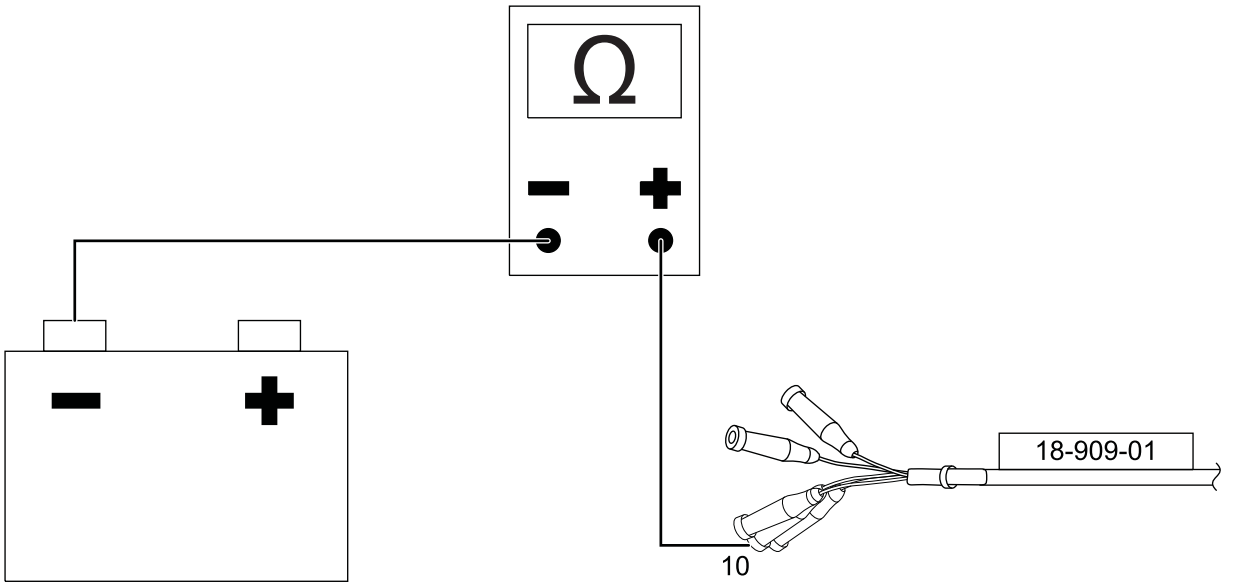


Figure 212 Test 1 DEF: SP Temperature / Control Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair intermittent short to ground between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 2.

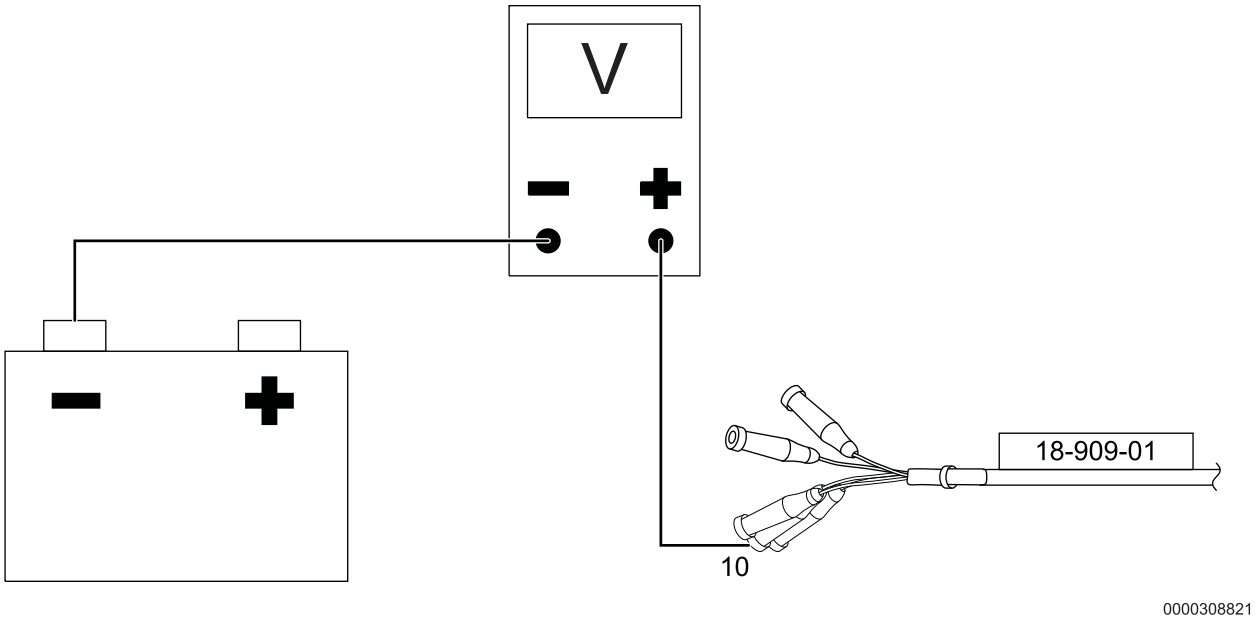


Figure 213 Test 2 DEF: SP Temperature / Control Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-909-01 pin-10 and known good ground.	Less than 1 volt
Decision	
Is voltage less than 1 volt?	Yes: Go to Test 3.
	No: Repair intermittent short to power between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 2.

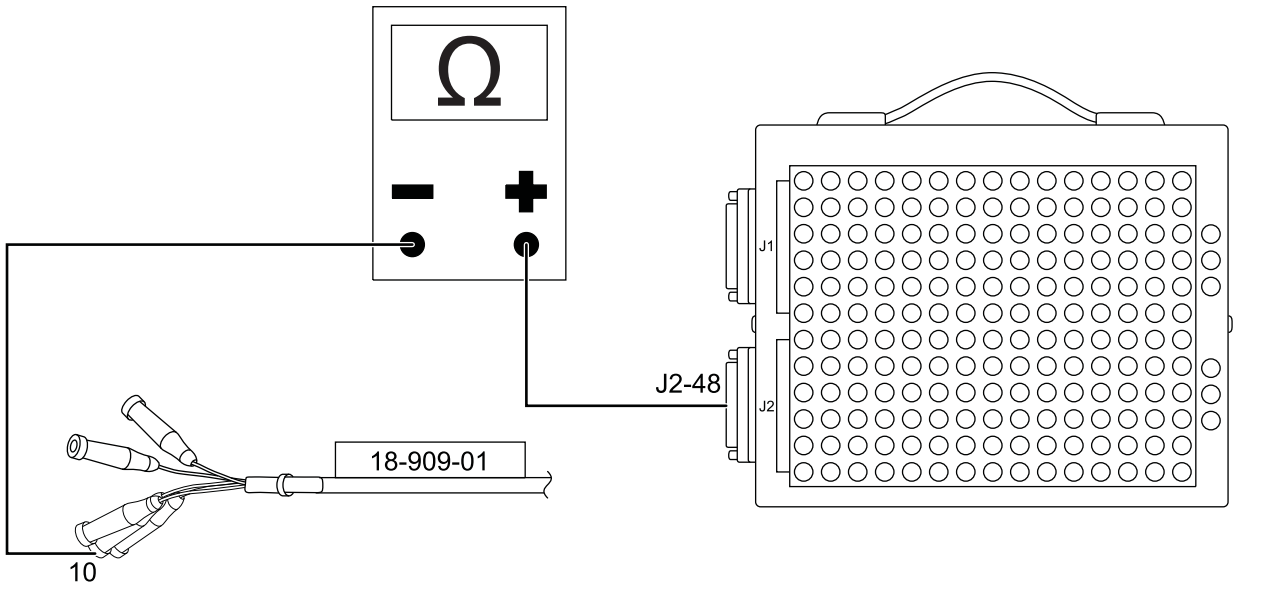


Figure 214 Test 3 DEF: SP Temperature / Control Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin breakout box. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and 180-pin breakout box pin J2-48.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, retest for SPN 4337 FMI 2.
	No: Repair intermittent Open or high resistance between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4337 FMI 2 fault code diagnostics.

SPN 4337 FMI 10 - DEF Dosing Unit Temperature abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) supply module temperature is in range but not rational (not heating).	Difference between maximum and minimum DEF supply module temperature is < 9°F (5°C) within 10 minutes	Valid DEF supply module temperature value is available Valid DEF Supply Module Heater (DEF: SMH) temperature value is available Initial DEF: SMH temperature at Key ON < 25°F (-4°C) DEF: SMH is active Diagnostic has not previously completed during this key cycle Key-On Engine-Running (KOER) The following fault codes must be inactive: SPN 3361 FMI 2 (DEF: SP Signal); SPN 4337 FMI 2 (DEF: SP Temp); SPN 5746 FMI 3, 4 (DEF: SMH Relay)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid (DEF) supply module is not heating properly.

Lamp Reaction

Malfunction Indicator Lamp will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 171 FMI 2, 3, 4 (AAT) • SPN 5746 (DEF: SMH Relay)	• SPN 3361 FMI 2 (DEF: SP Signal) • SPN 5798 (DEF: SMH Temperature)	• SPN 4337 FMI 2 (DEF: SP Temp)	• SPN 5745 (DEF: SMH)

Fault Facts

None

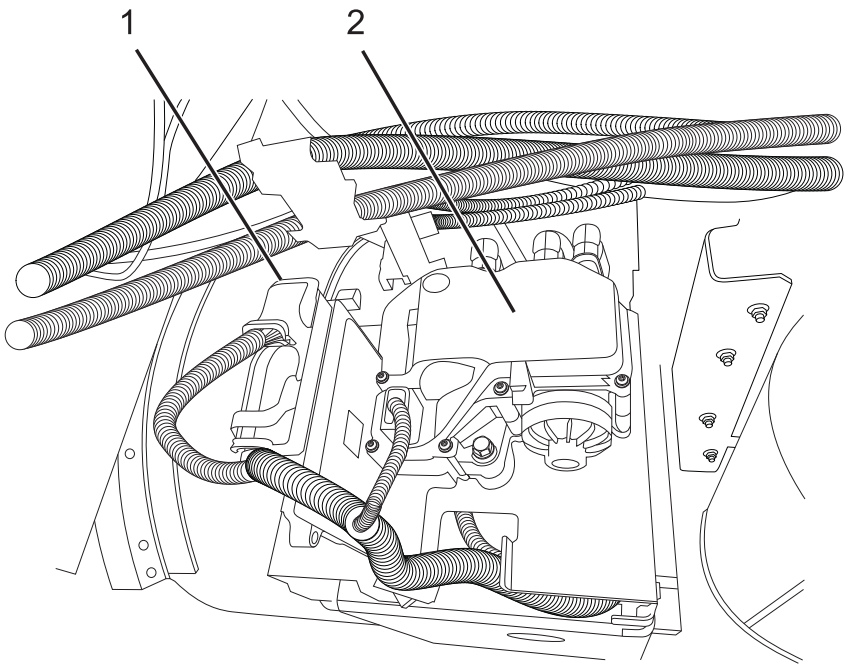
Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Diesel Exhaust Fluid Supply Pump (DEF: SP) Temperature / CTL circuit intermittent short to GND
- DEF: SP Temp / CTL circuit intermittent short to PWR
- DEF: SP Temp / CTL circuit intermittent Open or high resistance
- Failed DEF supply module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 621). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4337 FMI 10.



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Figure 215 DEF Supply Module Location (Typical)

1. ACM
2. DEF supply module

Step 2	Inspect connections at DEF supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connectors. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connectors, harnesses, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4337 FMI 10.

Step 3	Inspect connections at ACM.	Decision
A. Key OFF. B. Disconnect ACM connectors. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4337 FMI 10.

Pin-Point Tests (SPN 4337 FMI 10)

DEF: SP and Temperature Sensor Circuit

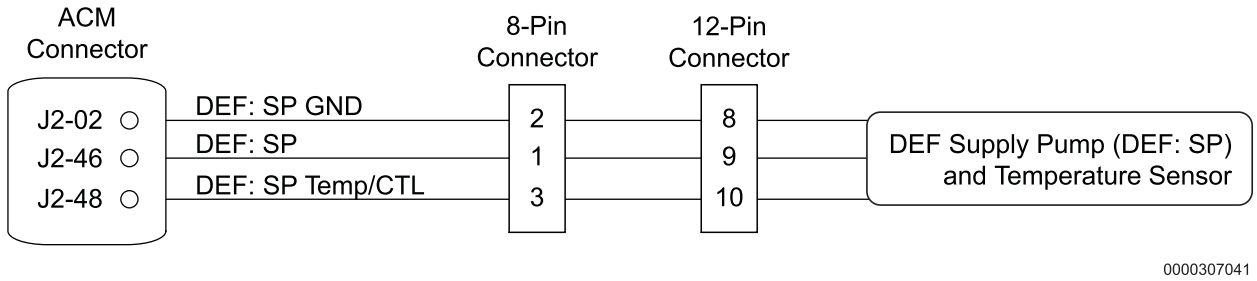


Figure 216 DEF: SP Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

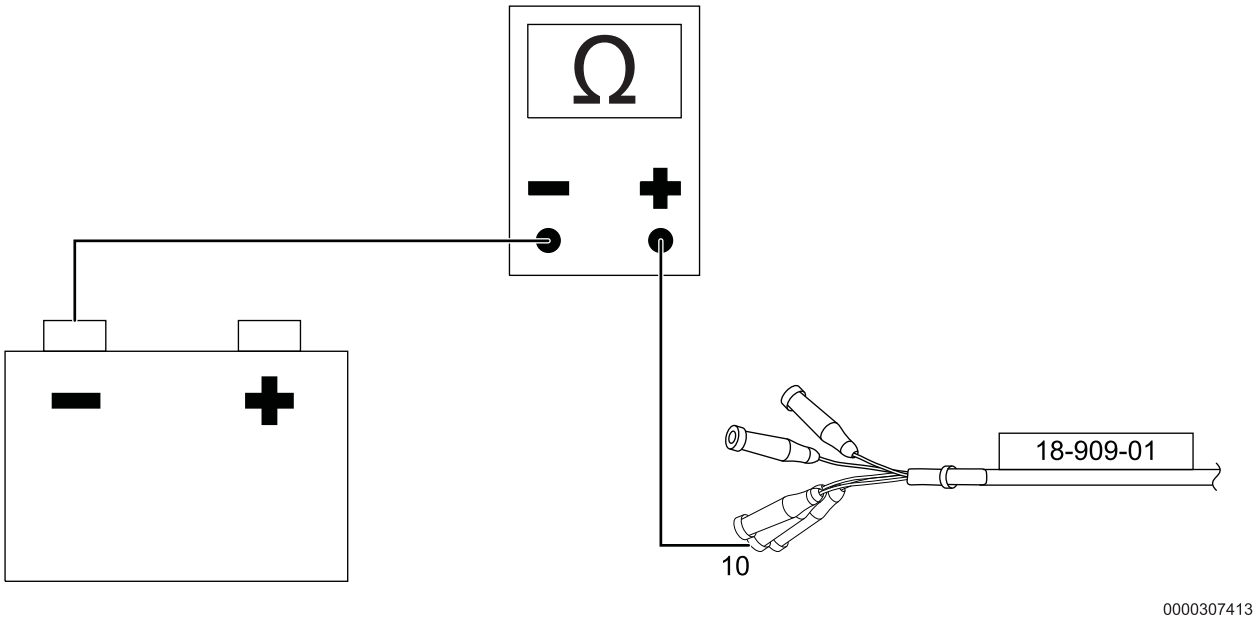


Figure 217 Test 1 DEF: SP Temperature / Control Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair intermittent short to ground between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 10.

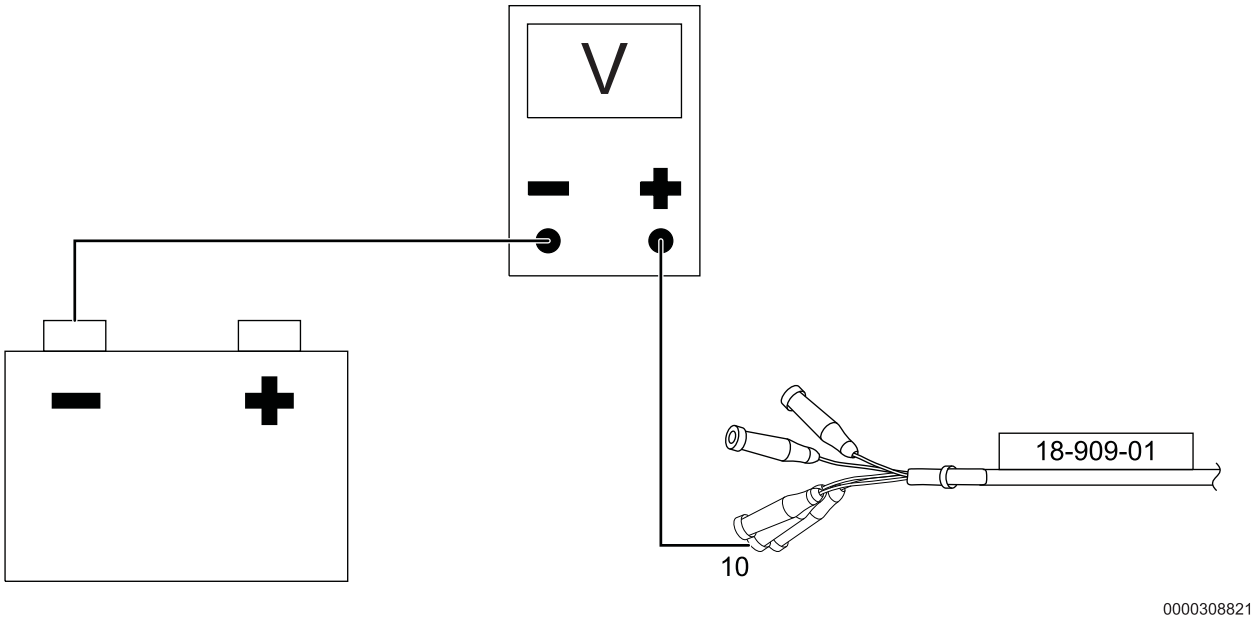


Figure 218 Test 2 DEF: SP Temperature / Control Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-909-01 pin-10 and known good ground.	Less than 1 volt
Decision	
Is voltage less than 1 volt?	Yes: Go to Test 3.
	No: Repair intermittent short to power between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 10.

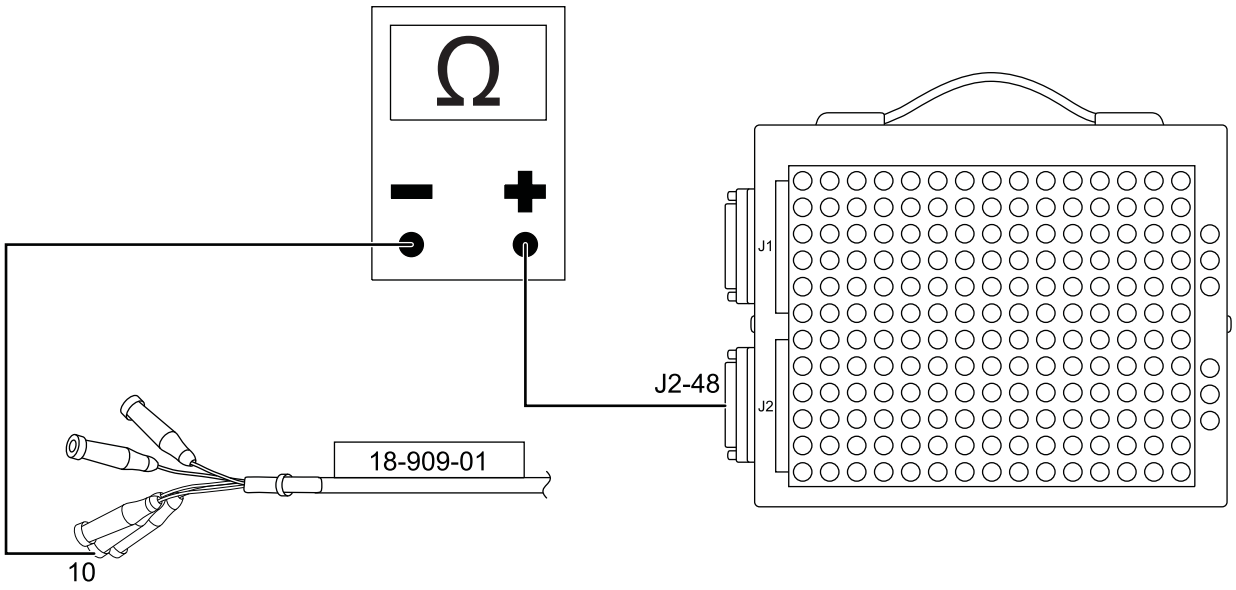


Figure 219 Test 3 DEF: SP Temperature / Control Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin breakout box. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and 180-pin breakout box pin J2-48.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, retest for SPN 4337 FMI 10.
	No: Repair intermittent Open or high resistance between DEF: SP connector pin-10 and ACM connector pin J2-48. After repairs are complete, retest for SPN 4337 FMI 10.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4337 FMI 10 fault code diagnostics.

DEFSLH (Diesel Exhaust Fluid Supply Line Heater)

Overview of DEFSLH Sensor Group

SPN	FMI	Description
4340	3	DEF Supply Line Heater Short to PWR (page 630)
4340	5	DEF Supply Line Heater open load/circuit (page 637)

Overview

Diesel Exhaust Fluid Supply Line Heater (DEFSLH) is used to maintain proper DEF temperature during cold conditions. DEFSLH is wrapped around supply line between DEF Doser Unit (DEF: DU) and DEF supply module. When DEF temperature is too low, Aftertreatment Control Module (ACM) turns on DEF Line Heater Relay (DEF: LHR) allowing power to be sent to DEFSLH.

SPN 4340 FMI 3 - DEF Supply Line Heater Short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Line Heater (DEFSLH) current is greater than expected.	DEFSLH current > 0.5 amps	Key ON The Diesel Exhaust Fluid Line Heater Relay is turned OFF

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from Diesel Exhaust Fluid Supply Line Heater (DEFSLH) is greater than 0.5 amps for 3 seconds. Engine torque will be reduced, and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 (Diesel Exhaust Fluid Line Heater Relay)			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and Diesel Exhaust Fluid Supply Line Heater (DEFSLH) share a common power circuit. If more than one Diesel Exhaust Fluid (DEF) line heater fault is set, suspect a common power circuit problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEFSLH circuit short to PWR
- Diesel Exhaust Fluid Line Heater Relay power circuit shorted to PWR between Diesel Exhaust Fluid Line Heater Relay pin-87 and DEFSLH pin-1
- Failed DEF Line Heater Relay

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 630).		Yes: Go to Step 2.
Is EST DTC free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4340 FMI 3.

Step 2	Inspect connections at Diesel Exhaust Fluid Supply Line Heater (DEFSLH) connector.	Decision
A. Key OFF. B. Disconnect DEFSLH connector. C. Check DEFSLH and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are the DEFSLH connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4340 FMI 3.

Step 3	Check DEFSLH Voltage.	Decision
Perform Test 1(page 633). Use DMM to measure voltage between Breakout Harness 18-045-01 pin-1 and known good ground.		Yes: Retest for SPN 4340 FMI 3.
Is voltage less than or equal to 0.5 volt?		No: Go to Step 4.

Step 4	Check DEFSLH Voltage.	Decision
Perform Test 2(page 636). Use a DMM to measure voltage between PDM terminal 87 for Diesel Exhaust Fluid Line Heater Relay and known good ground.		No: Repair short to PWR between PDM terminal 87 for the Diesel Exhaust Fluid Line Heater Relay and the DEFSLH connector pin-1. After repairs are complete, retest for SPN 4340 FMI 3.
Is voltage less than or equal to 0.5 volt?		Yes: Replace the Diesel Exhaust Fluid Line Heater Relay. After repairs are complete, retest for SPN 4340 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4340 FMI 3 fault code diagnostics.

Pin-Point Tests (SPN 4340 FMI 3)

DEF Line Heater Relay Circuit

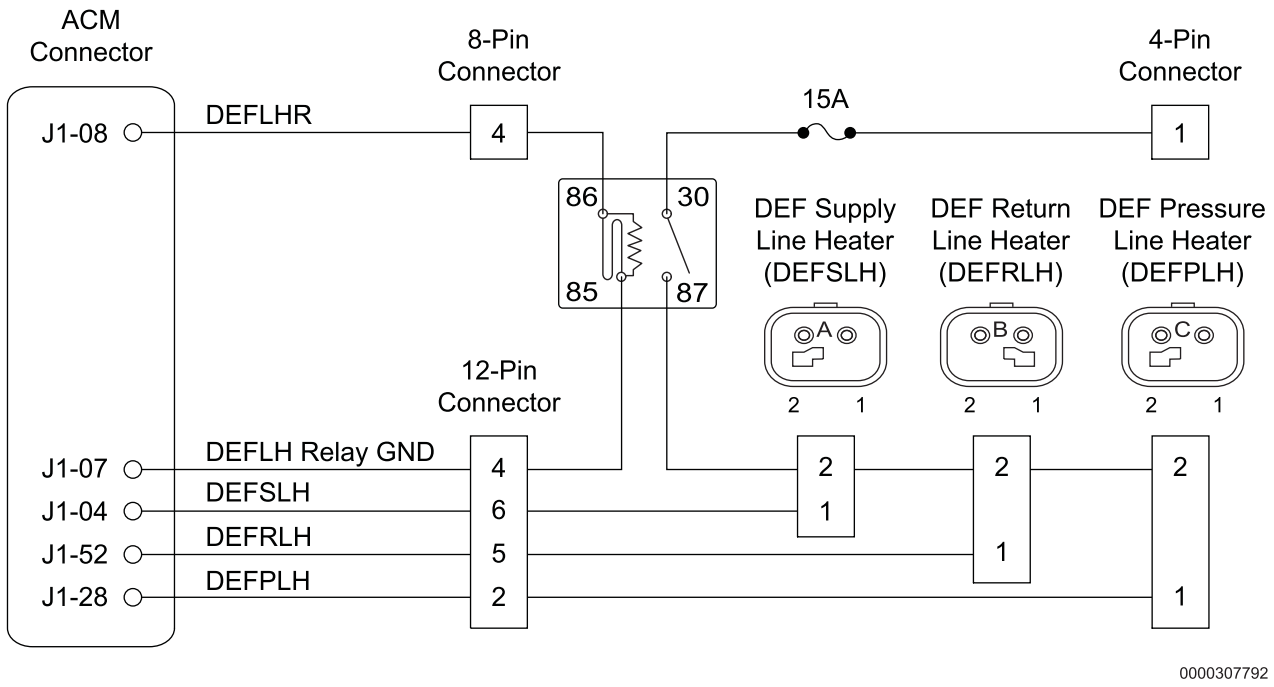


Figure 220 Diesel Exhaust Fluid Supply Line Heater (DEFSLH) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-045-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

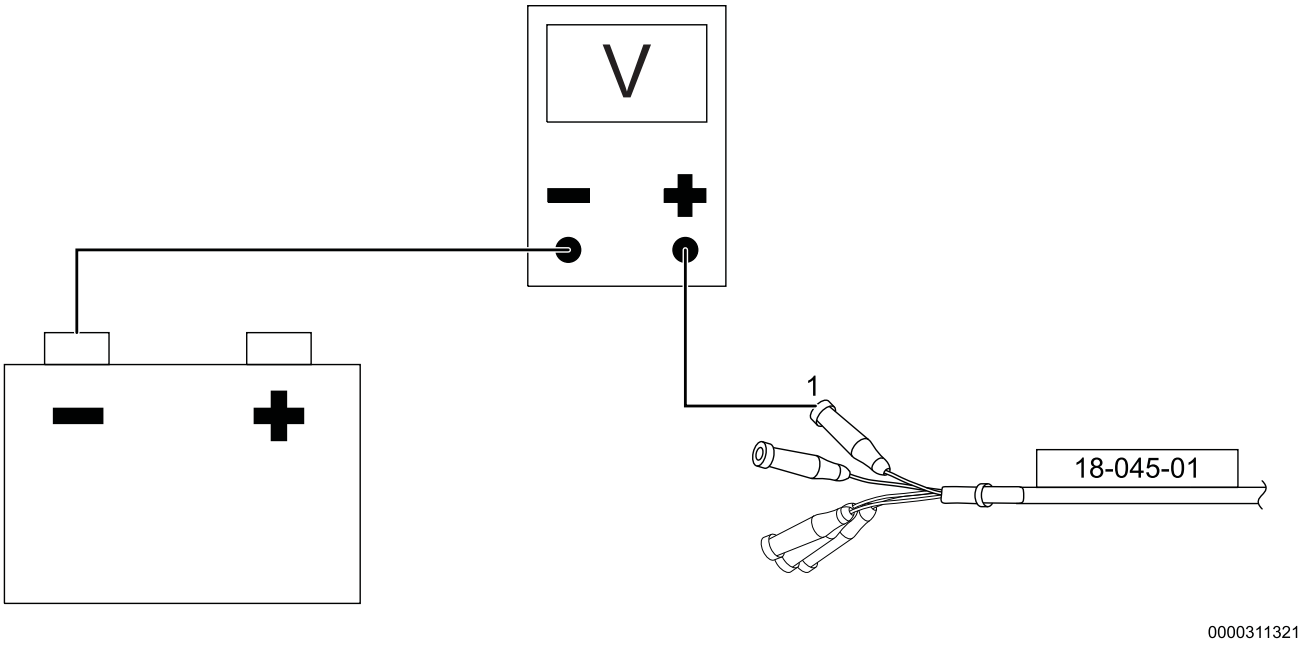


Figure 221 Test 1 DEFSLH Voltage Check

Test 1
A. Key OFF.
B. Disconnect Diesel Exhaust Fluid Supply Line Heater (DEFSLH) vehicle harness connector.
C. Connect Breakout Harness 18-045-01 to vehicle harness connector and leave DEFSLH disconnected.
D. Key ON.

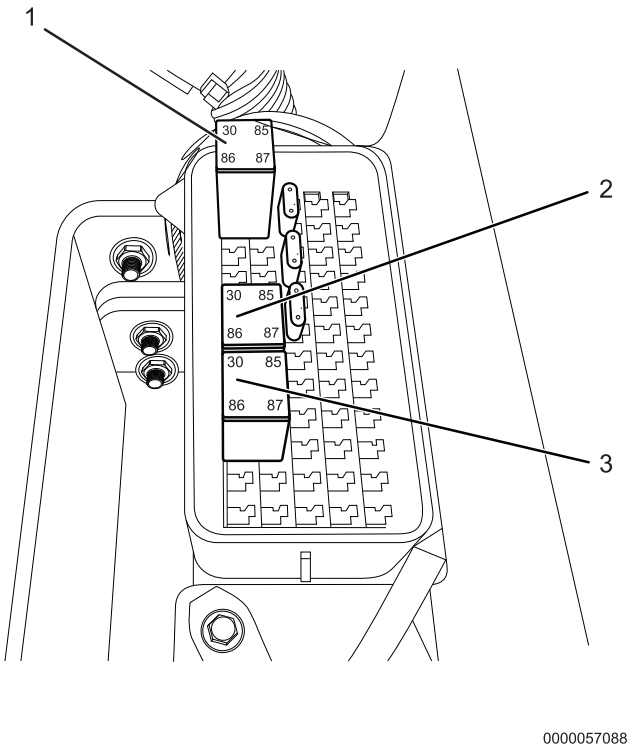


Figure 222 Power Distribution Module (PDM) Fuses and Relays

1. Diesel Exhaust Fluid Line Heater Relay
2. Diesel Exhaust Fluid Supply Module Heater (DEFSMH) Relay
3. Switched ignition relay

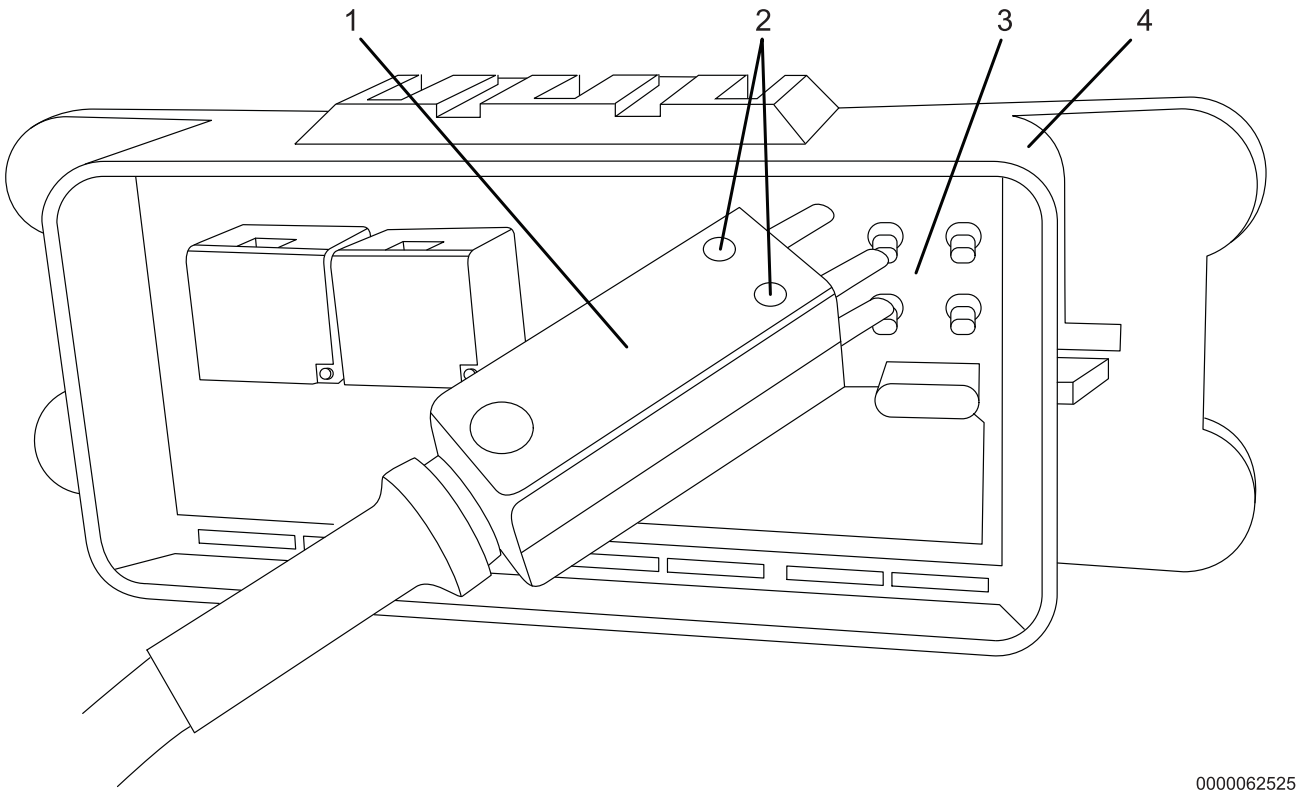


Figure 223 Installation of Breakout Harness ZTSE4908 (Typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with the dimples toward the top of the Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

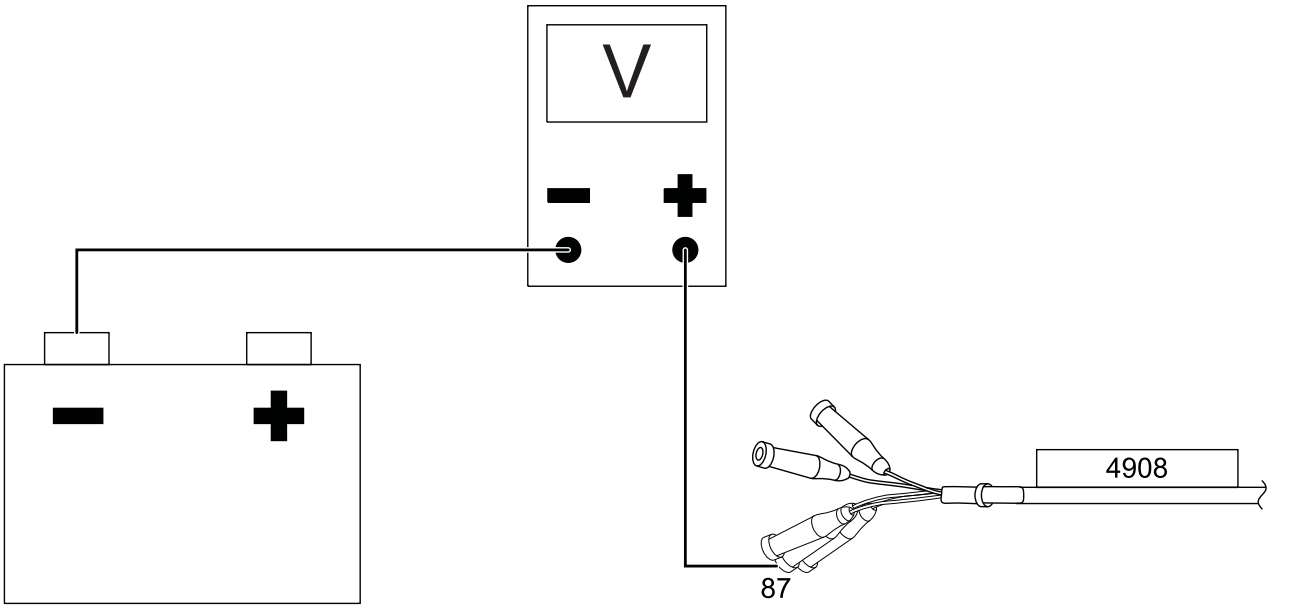


Figure 224 Test 2 DEFSLH Voltage Check

Test 2
A. Key OFF.
B. Remove Diesel Exhaust Fluid Line Heater Relay.
C. Install Breakout Harness ZTSE4908 and leave relay disconnected.
D. Key ON.

SPN 4340 FMI 5 - DEF Supply Line Heater open load/circuit

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Line Heater (DEFSLH) circuit is Open. Current is less than expected.	DEFSLH current < 0.3 amps	Key ON DEF Line Heater Relay command ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from the Diesel Exhaust Fluid Supply Line Heater (DEFSLH) is less than 0.3 amps. Engine torque will be reduced and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 (DEF Line Heater Relay)			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and DEFSLH share a common power circuit. If more than one DEF line heater fault is set, suspect a common power circuit problem.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Failed DEFSLH
- DEFSLH circuit Open or high resistance
- DEFSLH circuit short to GND
- DEFSLH power circuit Open or high resistance
- DEFSLH power circuit short to GND
- Blown fuse or Open power circuit to DEF Line Heater Relay
- Failed DEF Line Heater Relay

Verify batteries are fully charged and connections are clean.

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 637).		Yes: Go to Step 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4340 FMI 5.

Step 2	Inspect connections at Diesel Exhaust Fluid Supply Line Heater (DEFSLH).	Decision
A. Key OFF. B. Disconnect DEFSLH connector. C. Check DEFSLH and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are DEFSLH connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4340 FMI 5.

Step 3	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Disconnect ACM connector. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 4.
Are the ACM connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4340 FMI 5.

Step 4		Decision
Perform Test 1(page 641). Use DMM to measure voltage between Breakout Harness 18-045-01 pin-1 and known good ground		Yes: Go to Step 10.
Is voltage within B+ ± 0.5 volts?		No: Go to Step 5.

Step 5	Verify fuse condition	Decision
Perform Test 2(page 643). Use the DMM to measure Voltage between breakout harness ZSTSE4908 pin 30 and a known good ground.		Yes: Go to Step 9.
Is voltage within B+ ± 0.5 volts?		No: Go to Step 6.

Step 6	Verify fuse condition	Decision
Perform Test 3(page 643). Use DMM to measure voltage between vehicle side (left) of DEF Line Heater Relay 15-amp fuse and known good ground.		Yes: Go to Step 7.
Is voltage within B+ ± 0.5 volts?		No: Repair Open between DEF Line Heater Relay 15-amp fuse and vehicle power. After repairs are complete retest for SPN 4340 FMI 5.

Step 7	Verify fuse condition	Decision
Perform Test 4(page 643). Replace DEF Line Heater Relay 15-amp fuse.		Yes: Repair short to ground between DEF Line Heater Relay 15-amp fuse and DEF Line Heater Relay pin-30. After repairs are complete, retest for SPN 4340 FMI 5.
Does the DEF Line Heater Relay 15-amp fuse blow immediately when replaced?		No: Go to Step 8.

Step 8	Check for short to GND.	Decision
Perform Test 5(page 644). Inspect to see if DEFLH Relay 15 amp fuse blows when DEF line heaters are actuated ON.		Yes: Repair short to ground between DEF Line Heater Relay PDM terminal 87 and DEFSLH. After repairs are complete, retest for SPN 4340 FMI 5.
Does the DEF Line Heater Relay 15-amp fuse blow when DEF line heaters are actuated ON?		No: Go to Step 9.

Step 9	Check for Open or high resistance circuit.	Decision
Perform Test 6(page 644). Use DMM to measure resistance between Breakout Harness ZTSE4908 PDM terminal 87 and Breakout Harness 18-045-01 pin-1.		Yes: Replace the DEF Line Heater Relay. After repairs are complete, retest for SPN 4340 FMI 5.
Is resistance less than 5 ohms?		No: Repair Open or high resistance between DEFPLH pin-1 and DEF Line Heater Relay PDM terminal 87. After repairs are complete, retest for SPN 4340 FMI 5.

Step 10	Check for Open or high resistance circuit.	Decision
Perform Test 7(page 644). Use DMM to measure voltage between Breakout Harness 18-045-01 pin-2 and known good PWR.		Yes: Go to Step 11.
Is voltage within B+ ± 0.5 volts?		No: Repair Open or high resistance between ACM pin J1-04 and DEFSLH pin-2. After repairs are complete, retest for SPN 4340 FMI 5.

Step 11	Measure for short to GND.	Decision
Perform Test 8(page 644). Use DMM to measure voltage between Breakout Harness 18-045-01 pin-2 and known good PWR.		Yes: Replace DEF supply line. After repairs are complete, retest for SPN 4340 FMI 5.
Is resistance greater than 1000 ohms?		No: Repair short to ground between ACM pin J1-04 and DEFSLH pin-2. After repairs are complete, retest for SPN 4340 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4340 FMI 5 fault code diagnostics.

Pin-Point Tests (SPN 4340 FMI 5)

DEF Line Heater Relay Circuit

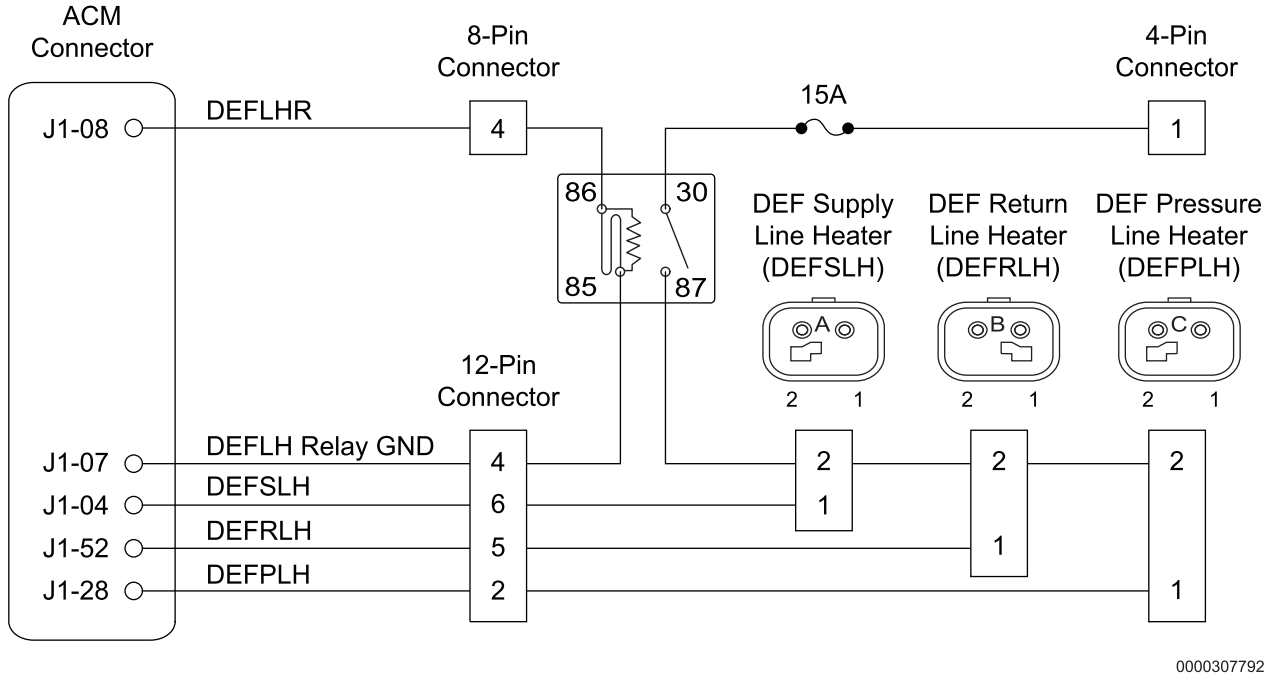


Figure 225 DEFPLH Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-045-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable

Test 1
A. Key OFF. B. Connect Breakout Harness 18-045-01 to Diesel Exhaust Fluid Supply Line Heater (DEFSLH) vehicle harness connector and leave DEFSLH disconnected. C. Key-On Engine-Off (KOEO). D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector(page 2124). E. Using EST with ServiceMaxx™ software, select Tests > KOEO Aftertreatment Tests > DEF Line Heater Test (page 2161). F. Select the desired time delay, then select "Start Test".

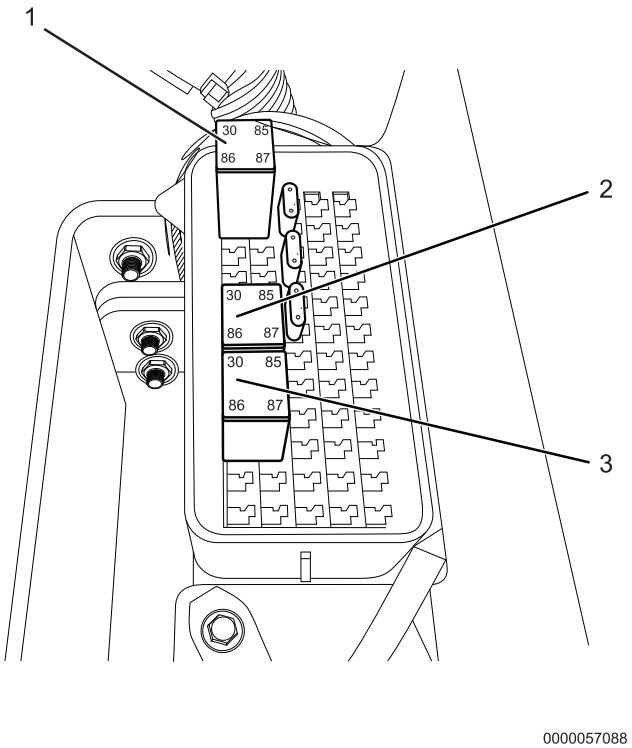


Figure 226 Power Distribution Module (PDM) Fuses and Relays

1. Diesel Exhaust Fluid Line Heater Relay
2. Diesel Exhaust Fluid Supply Module Heater (DEFSMH) Relay
3. Switched Ignition Relay

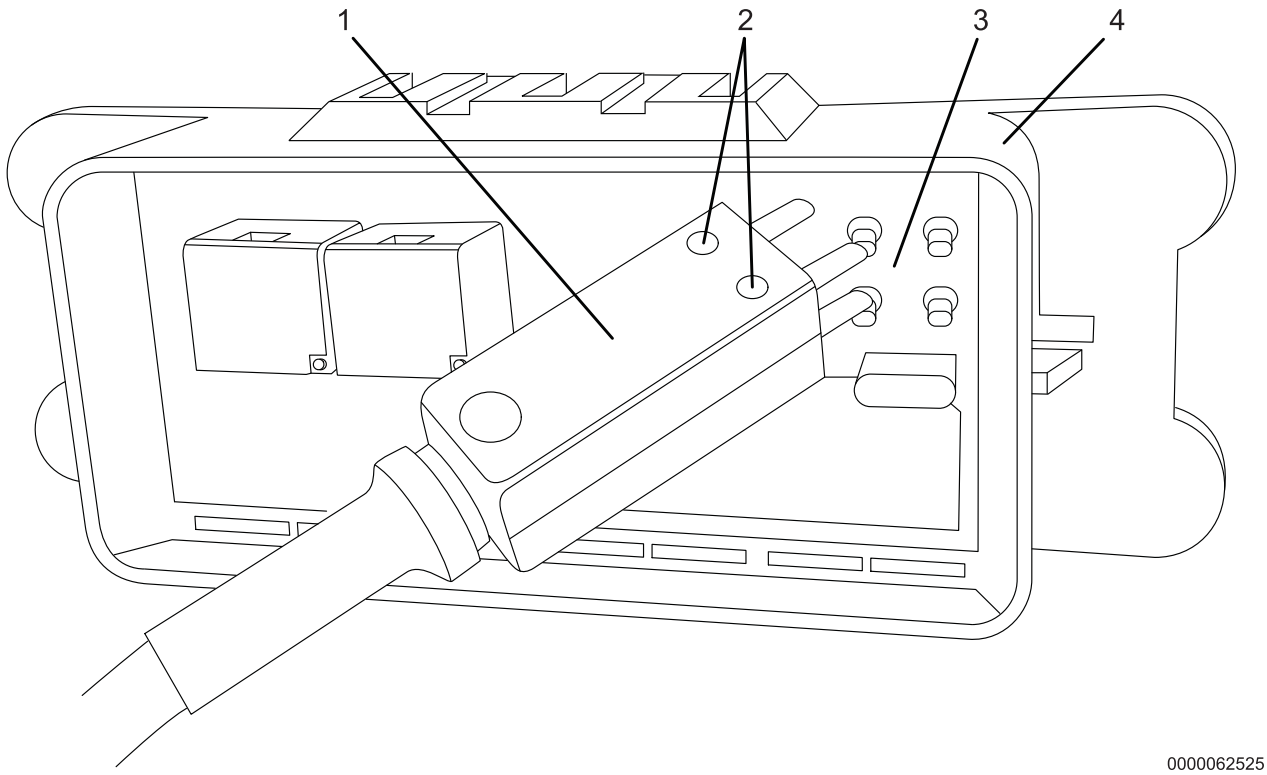


Figure 227 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with the dimples toward the top of the Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

Test 2
A. Remove DEF Line Heater Relay.
B. Connect Breakout Harness ZTSE4908 to DEF Line Heater Relay location in PDM and leave DEF Line Heater Relay disconnected.

Test 3
A. Key OFF.
B. Remove the DEF Line Heater 15 amp fuse.
C. Key-On Engine-Off (KOEO).

Test 4
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Line Heater Relay and leave disconnected.

Test 5
A. Key OFF. B. Install Diesel Exhaust Fluid Line Heater Relay. C. Key-On Engine-Off (KOEO). D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Using ServiceMaxx™ software, select KOEO Aftertreatment Tests > DEF Line Heater Test (page 2161). F. Select the desired time delay, then select "Start Test".

Test 6
A. Key OFF. B. Connect Breakout Harness 18-045-01 to vehicle harness connector and leave Diesel Exhaust Fluid Supply Line Heater (DEFSLH) disconnected. C. Connect Breakout Harness ZTSE4908 to Power Distribution Module (PDM) with DEF Line Heater Relay disconnected.

Test 7
A. Key OFF. B. Connect Breakout Harness 18-045-01 to vehicle harness with Diesel Exhaust Fluid Supply Line Heater (DEFSLH) disconnected. C. Key-On Engine-Off (KOEO).

Test 8
A. Key OFF. B. Disconnect Aftertreatment Control Module (ACM) vehicle harness. C. Connect Breakout Harness 18-045-01 to Diesel Exhaust Fluid Supply Line Heater (DEFSLH) vehicle harness connector, and leave DEFSLH disconnected.

DEFRLH (Diesel Exhaust Fluid Return Line Heater)

Overview of DEFRLH Sensor Group

SPN	FMI	Description
4342	3	DEF Return Line Heater Short to PWR (page 646)
4342	5	DEF Return Line Heater open load/circuit (page 653)

Overview

Diesel Exhaust Fluid Return Line Heater (DEFRLH) is used to prevent Diesel Exhaust Fluid (DEF) freezing during cold conditions. DEFRLH is wrapped around return line between DEF tank and DEF supply module. When DEF temperature is too low, Aftertreatment Control Module (ACM) turns on the DEF Line Heater Relay allowing power to be sent to DEFRLH.

SPN 4342 FMI 3 - DEF Return Line Heater Short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Return Line Heater (DEFRLH) current is greater than expected.	DEFRLH current > 0.5 amps	Key ON DEF Line Heater Relay is turned OFF

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from Diesel Exhaust Fluid Return Line Heater (DEFRLH) is greater than 0.5 amps for 3 seconds. Engine torque will be reduced and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 (DEF Line Heater Relay)			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and Diesel Exhaust Fluid Supply Line Heater (DEFSLH) share a common power circuit. If more than one Diesel Exhaust Fluid (DEF) line heater fault is set, suspect a common power circuit problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEFRLH circuit short to PWR
- DEFRLH power circuit shorted to PWR between DEF Line Heater Relay pin-87 and DEF: L2HC pin-1
- Failed DEFRLH

Step 1	Check for associated faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 646).		Yes: Go to Step 2.
Is EST DTC free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4342 FMI 3.

Step 2	Inspect connections at DEFRLH connector.	Decision
A. Key OFF. B. Disconnect DEFRLH connector. C. Check DEFRLH and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are DEFRLH connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4342 FMI 3.

Step 3	Check DEFRLH Voltage.	Decision
Perform Test 1(page 649). Use DMM to measure voltage between Breakout Harness 18-046-01 pin-1 and known good GND.		Yes: Retest for SPN 4340 FMI 3.
Is voltage less than or equal to 0.5 volt?		No: Go to Step 4.

Step 4	Check DEFRLH Voltage.	Decision
Perform Test 2(page 652). Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-87 and known good ground.		Yes: Replace DEF Line Heater Relay. After repairs are complete, retest for SPN 4342 FMI 3.
Is voltage less than or equal to 0.5 volt?		No: Repair short to PWR between DEF Line Heater Relay pin-87 and DEFRLH connector pin-1. After repairs are complete, retest for SPN 4342 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to 4342 FMI 3 fault code diagnostics.

Pin-Point Tests (SPN 4342 FMI 3)

DEF Line Heater Relay Circuit

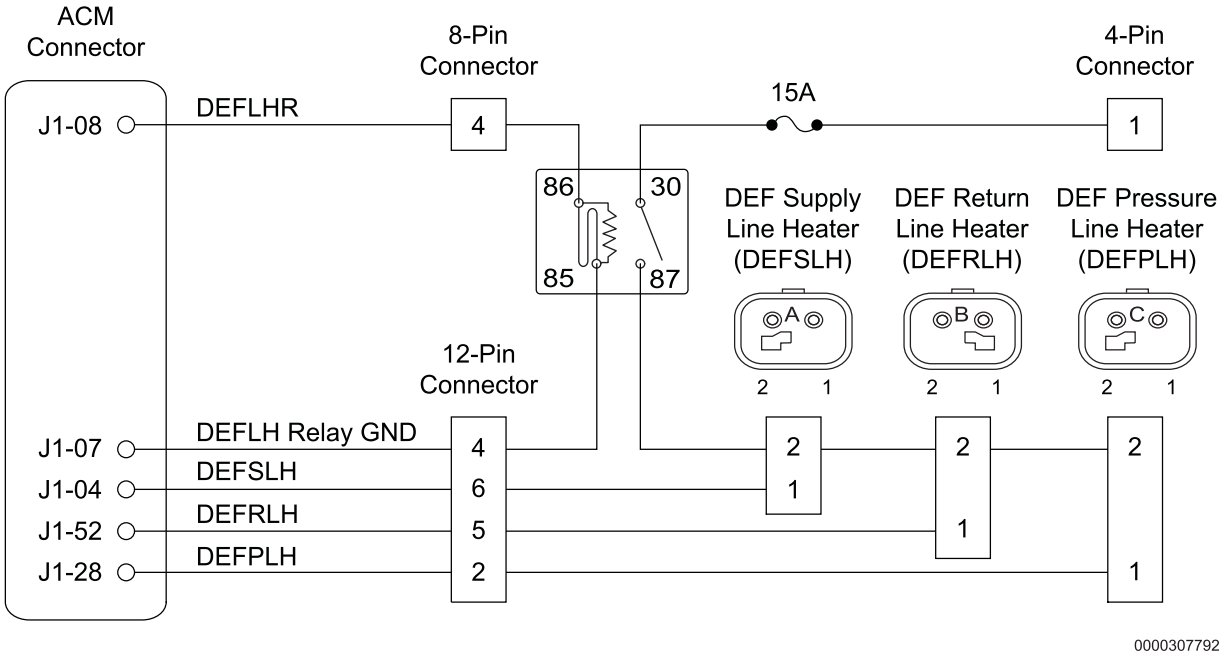


Figure 228 Diesel Exhaust Fluid Line Heater Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-046-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

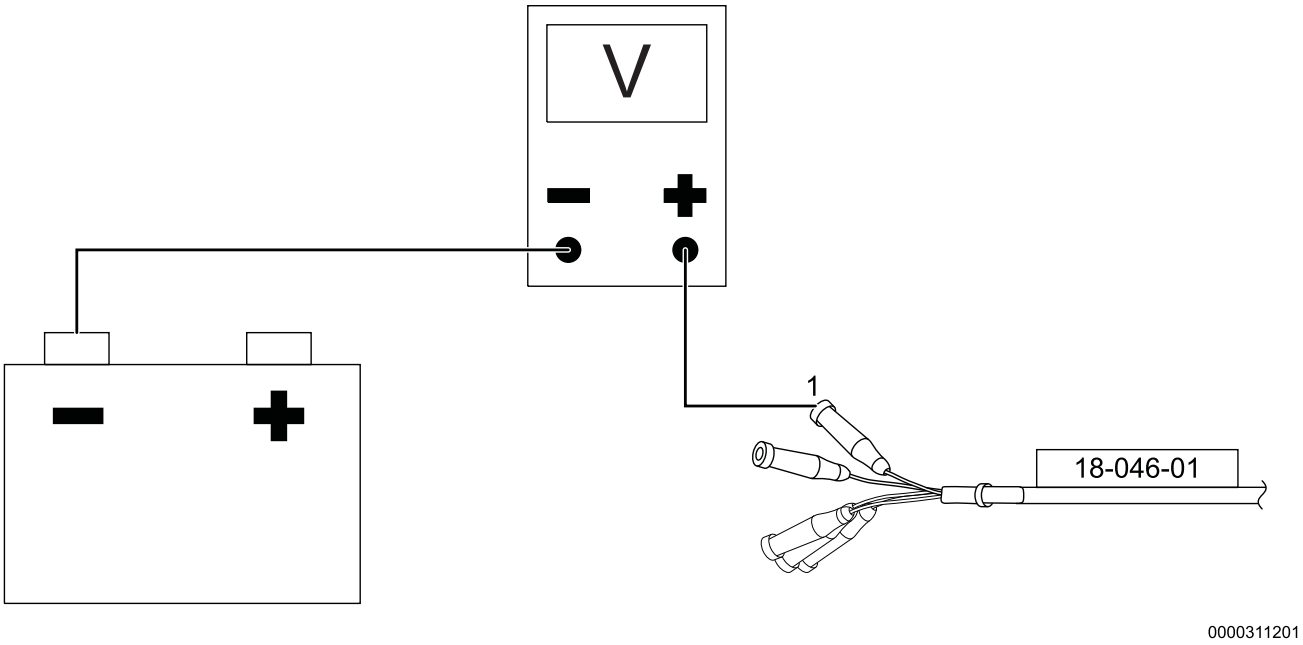


Figure 229 Test 1 DEFRLH Voltage Check

Test 1
A. Key OFF.
B. Disconnect DEFRLH vehicle harness connector.
C. Connect Breakout Harness 18-046-01 to vehicle harness connector and leave DEFRLH disconnected.
D. Key ON.

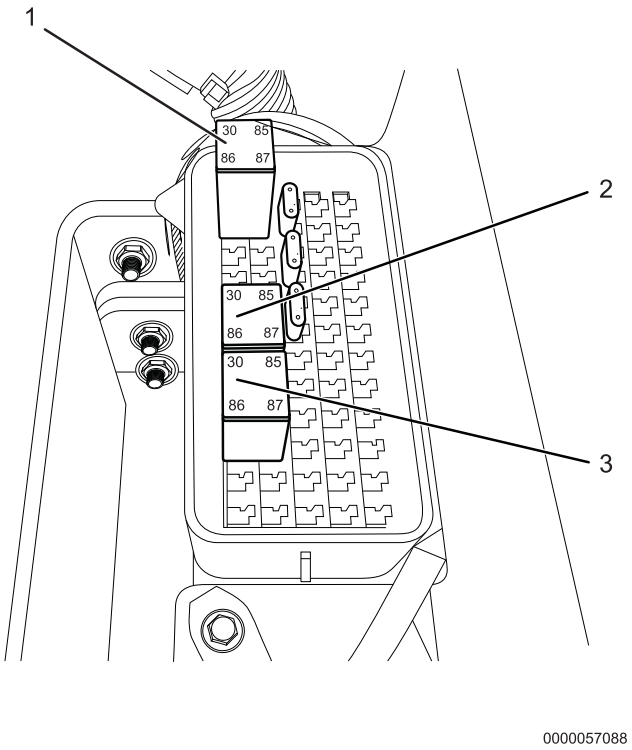


Figure 230 Power Distribution Module (PDM) Fuses and Relays

1. DEF Line Heater Relay
2. DEF Supply Module Heater Relay (DEFSMH Relay)
3. Switched ignition relay

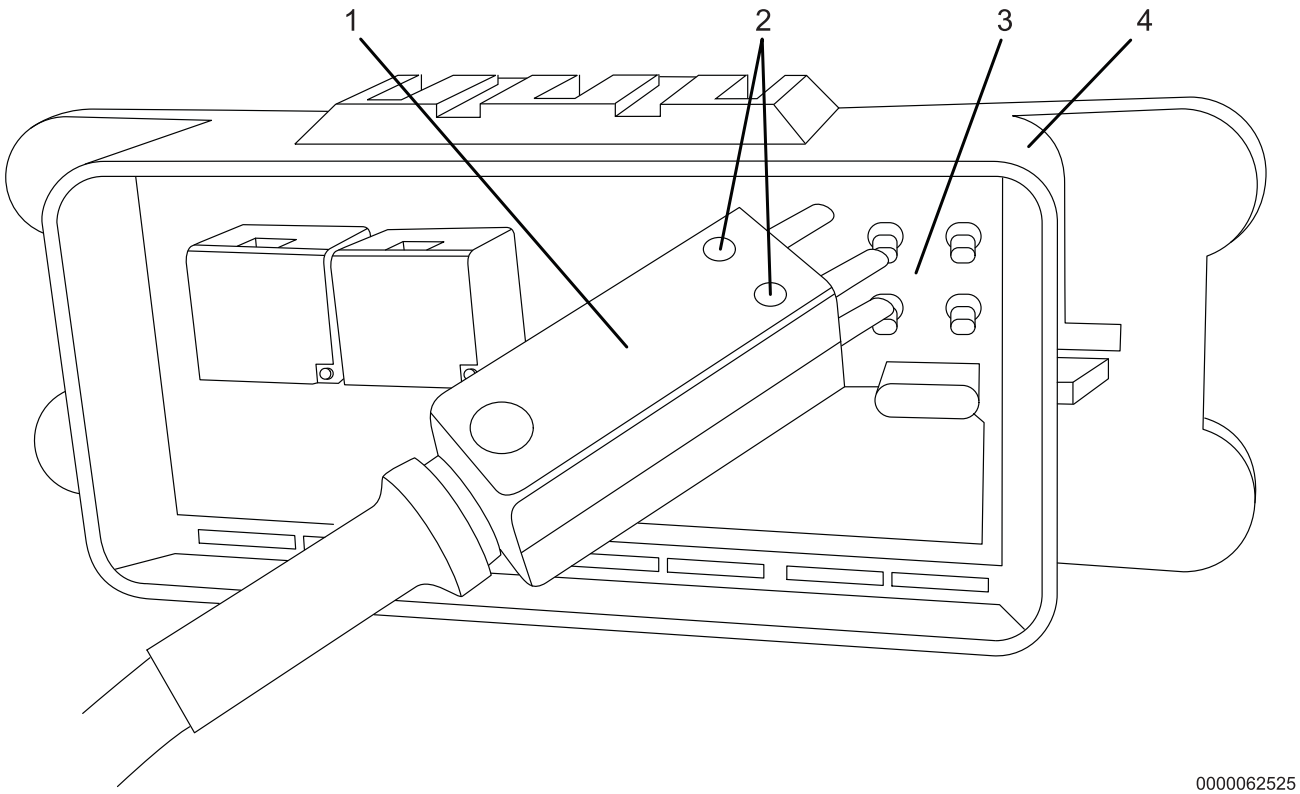


Figure 231 Installation of Breakout Harness ZTSE4908 (Typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with dimples toward top of Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

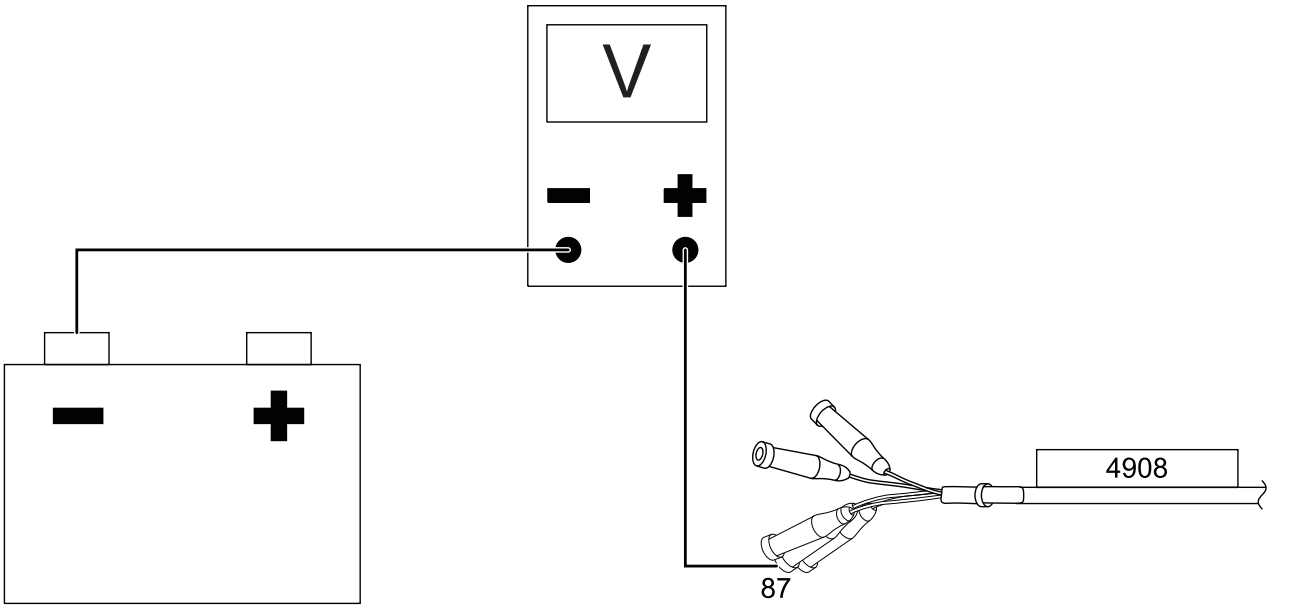


Figure 232 Test 2 DEF: L2HC Voltage Check

Test 2
A. Key OFF.
B. Remove DEF Line Heater Relay.
C. Install Breakout Harness ZTSE4908 and leave relay disconnected.
D. Key ON.

SPN 4342 FMI 5 - DEF Return Line Heater open load/circuit

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Return Line Heater (DEFRLH) control circuit Open. Current less than expected.	DEFRLH current > 0.3 amps	Key ON The Diesel Exhaust Fluid Line Heater Relay is turned ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from Diesel Exhaust Fluid Return Line Heater (DEFRLH) is less than 0.3 amps. Engine torque will be reduced and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 (DEF Line Heater Relay)			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and Diesel Exhaust Fluid Supply Line Heater (DEFSLH) share a common power circuit. If more than one Diesel Exhaust Fluid (DEF) line heater fault is set, suspect a common power circuit problem.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Failed DEFRLH
- DEFRLH circuit Open or high resistance
- DEFRLH circuit short to GND
- DEFRLH power circuit Open or high resistance
- DEFRLH power circuit short to GND
- Blown fuse or Open power circuit to DEF Line Heater Relay
- Failed DEF Line Heater Relay

Verify batteries are fully charged and connections are clean.

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 653).		Yes: Go to Step 2.
Is EST DTC free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4342 FMI 5.

Step 2	Inspect connections at DEFRLH connector.	Decision
A. Key OFF. B. Disconnect DEFRLH connector. C. Check DEFRLH and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are DEFRLH connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4342 FMI 5.

Step 3	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Disconnect ACM connector. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 4.
Are ACM connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4342 FMI 5.

Step 4		Decision
Perform Test 1(page 657). Use DMM to measure voltage between Breakout Harness 18-046-01 pin-1 and known good ground while the DEF Line Heater Test is running.		Yes: Go to Step 10.
Is voltage within B+ ± 0.5 volts?		No: Go to Step 5.

Step 5	Check DEFRLH voltage.	Decision
Perform Test 2(page 660). Use DMM to measure voltage between breakout harness ZSTSE4908 pin 30 and a known good ground.		Yes: Go to Step 9.
Is voltage within B+ ± 0.5 volts?		No: Go to Step 6.

Step 6	Check DEF Line Heater Relay voltage.	Decision
Perform Test 3(page 660). Use DMM to check for voltage between vehicle side (left) of DEF Line Heater Relay 15 amp fuse and known good ground.		Yes: Go to Step 7.
Is voltage within B+ ± 0.5 volts?		No: Repair Open or high resistance between DEF Line Heater Relay 15 amp fuse and vehicle PWR. After repairs are complete retest for SPN 4342 FMI 5.

Step 7	Verify fuse condition	Decision
Perform Test 4(page 660). Replace DEF Line Heater Relay 15 amp fuse.		Yes: Repair short to ground (GND) between DEF Line Heater Relay 15 amp fuse and DEF Line Heater Relay pin-30. After repairs are complete, retest for SPN 4342 FMI 5.
Does DEF Line Heater Relay 15 amp fuse blow immediately when replaced?		No: Go to Step 8.

Step 8	Check for associated faults.	Decision
Perform Test 5(page 660). Inspect to see if DEFLH Relay 15 amp fuse blows when DEF line heaters are actuated ON.		Yes: Repair short GND between DEF Line Heater Relay pin-87 and DEFRLH. After repairs are complete, retest for SPN 4342 FMI 5.
Does the DEF Line Heater Relay 15-amp fuse blow when DEF line heaters are actuated ON?		No: Go to Step 9.

Step 9	Check for Open or high resistance.	Decision
Perform Test 6(page 661). Using DMM, measure resistance between Breakout Harness ZTSE4908 pin-87 and Breakout Harness 18-046-01 pin-1.		Yes: Replace the DEF Line Heater Relay. After repairs are complete, retest for SPN 4342 FMI 5.
Is resistance less than 5 ohms?		No: Repair open or high resistance between DEFRLH pin-1 and DEF Line Heater Relay pin-87. After repairs are complete, retest for SPN 4342 FMI 5.

Step 10	Check for Open or high resistance.	Decision
Perform Test 7(page 661). Use DMM to measure voltage between Breakout Harness 18-046-01 pin-2 and known good PWR. Is voltage within B+ ± 0.5 volts?		Yes: Go to Step 11. No: Repair Open or high resistance between ACM pin J1-52 and DEFRLH pin-2. After repairs are complete, retest for SPN 4342 FMI 5.

Step 11	Check for short to ground.	Decision
Perform Test 8(page 661). Using DMM, measure voltage between Breakout Harness 18-046-01 pin-2 and known good PWR. Is voltage within B+ ± 0.5 volts?		Yes: Replace DEF Return Line. After repairs are complete, retest for SPN 4342 FMI 5. No: Repair short to ground between ACM pin J1-52 and DEFRLH pin-2. After repairs are complete, retest for SPN 4342 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to 4342 FMI 5 fault code diagnostics.

Pin-Point Tests (SPN 4342 FMI 5)

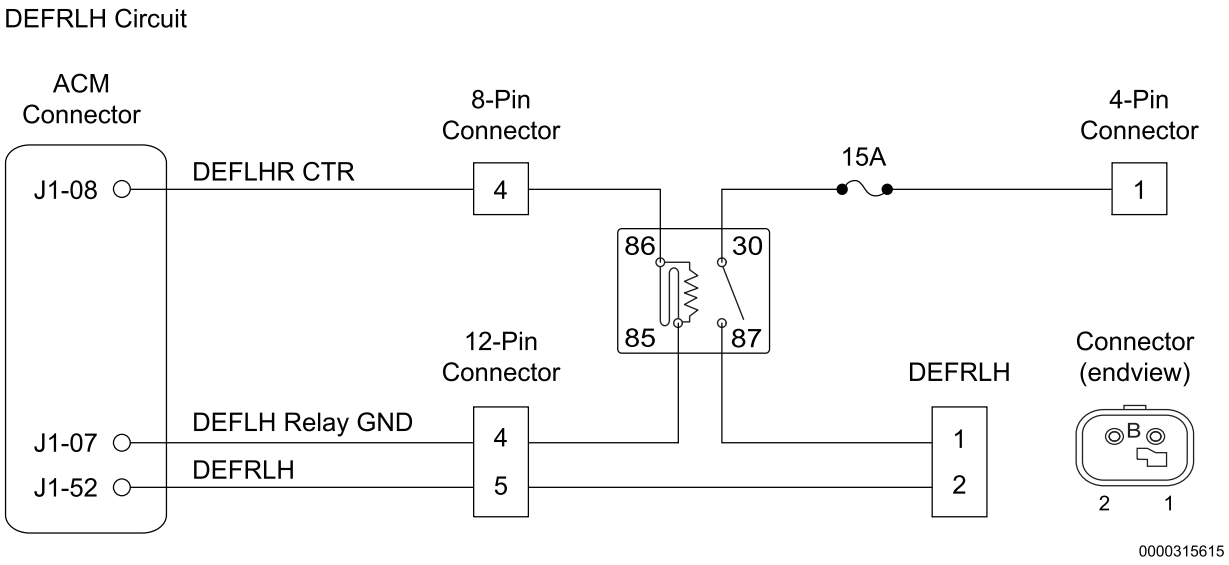


Figure 233 DEFRLH Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-046-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable

Test 1
A. Key OFF.
B. Connect Breakout Harness 18-046-01 to vehicle harness connector and leave DEFRLH disconnected.
C. Key-On Engine-Off (KOEO).
D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector(page 2124).
E. Using EST with ServiceMaxx™ software, select Tests > KOEO Aftertreatment Tests > DEF Line Heater Test (page 2161).
F. Select the desired time delay, then select "Start Test".

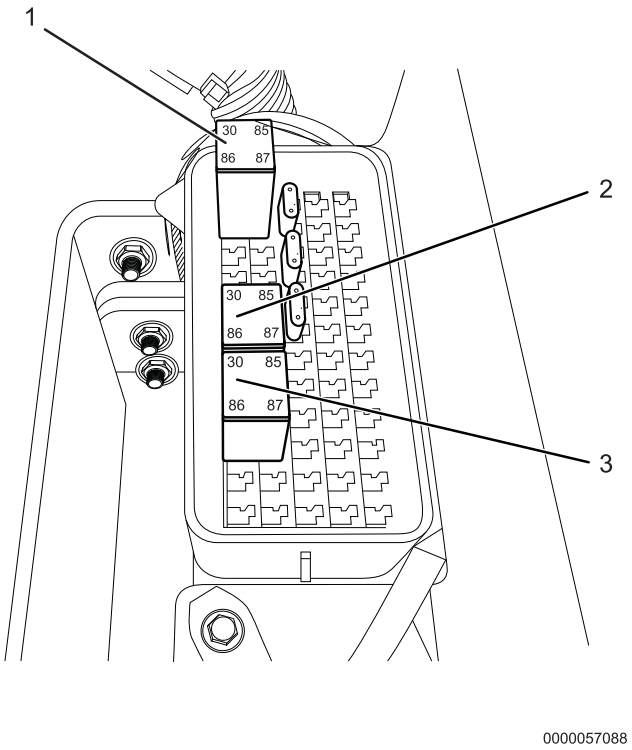


Figure 234 Power Distribution Module (PDM) Fuses and Relays

1. Diesel Exhaust Fluid Line Heater Relay
2. Diesel Exhaust Fluid Supply Module Heater Relay (DEFSMH Relay)
3. Switched ignition relay

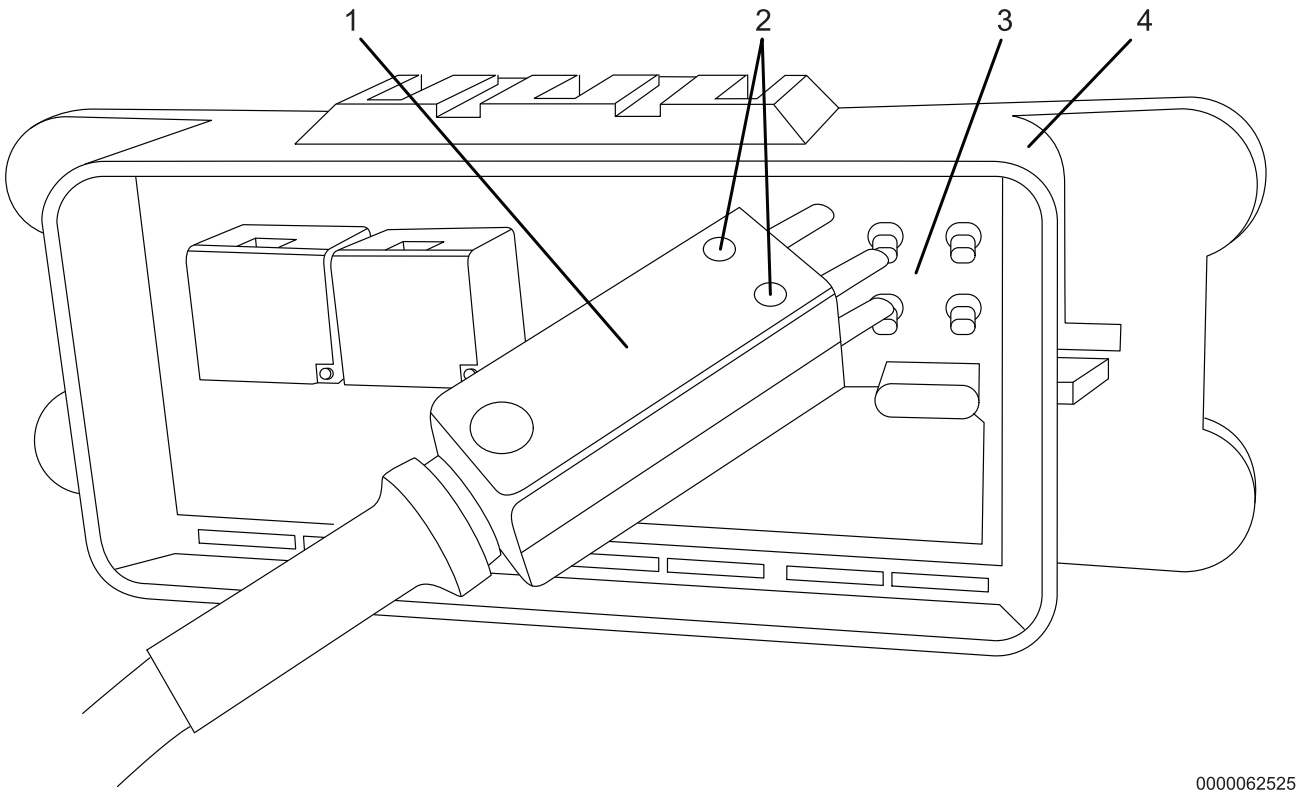


Figure 235 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. Power Distribution Module (PDM)

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with dimples toward top of Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

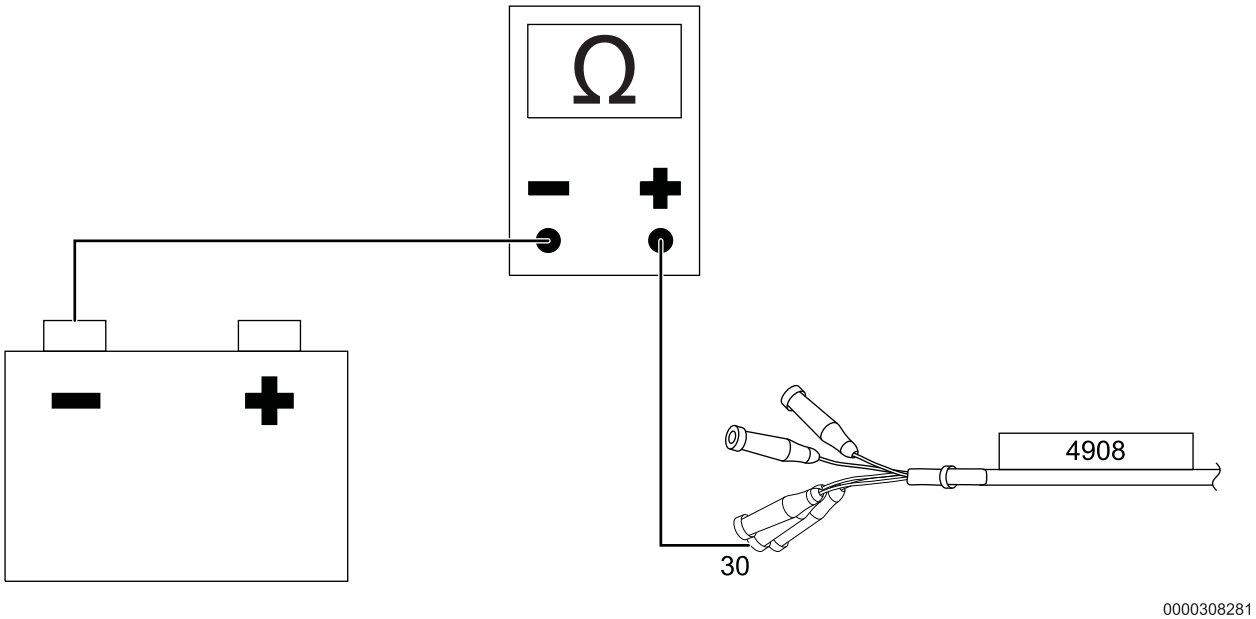


Figure 236 Test 2 DEFRLH Voltage Check

Test 2
A. Key OFF.
B. Remove Diesel Exhaust Fluid Line Heater Relay.
C. Install Breakout Harness ZTSE4908 and leave relay disconnected.
D. Key ON.

Test 3
A. Key OFF.
B. Remove the DEF Line Heater 15 amp fuse.
C. Key-On Engine-Off (KOEO).

Test 4
A. Key OFF.
B. Remove DEF Line Heater Relay.

Test 5
A. Key OFF. B. Install Diesel Exhaust Fluid Line Heater Relay. C. Key-On Engine-Off (KOEO). D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector(page 2124). E. Using EST with ServiceMaxx™ software, select Tests > KOEO Aftertreatment Tests > DEF Line Heater Test (page 2161). F. Select the desired time delay, then select "Start Test".

Test 6
A. Key OFF. B. Connect Breakout Harness 18-046-01 to vehicle harness connector and leave Diesel Exhaust Fluid Return Line Heater (DEFRLH) disconnected. C. Connect Breakout Harness ZTSE4908 to Power Distribution Module (PDM) with DEF Line Heater Relay disconnected..

Test 7
A. Key OFF. B. Connect Breakout Harness 18-046-01 to vehicle harness with Diesel Exhaust Fluid Return Line Heater (DEFRLH) disconnected. C. Key-On Engine-Off (KOEO).

Test 8
A. Key OFF. B. Disconnect Aftertreatment Control Module (ACM) vehicle harness. C. Connect Breakout Harness 18-046-01 to Diesel Exhaust Fluid Return Line Heater (DEFRLH) vehicle harness connector, and leave DEFRLH disconnected.

DEF: RCV (Diesel Exhaust Fluid Return Valve)

Overview of DEF: RCV Sensor Group

SPN	FMI	Description
4376	3	DEF Reverting Control Valve short to PWR (page 663)
4376	4	DEF Reverting Control Valve short to GND (page 669)
4376	7	DEF Reverting Control Valve - Mechanical system not responding or out of adjustment (page 675)

Overview

Diesel Exhaust Fluid Return Valve (DEFRV) controls Diesel Exhaust Fluid (DEF) flow through DEF supply module. When DEFRV is energized DEF is returned to DEF tank through DEF return line. DEFRV is not serviceable individually and is part of DEF supply module.

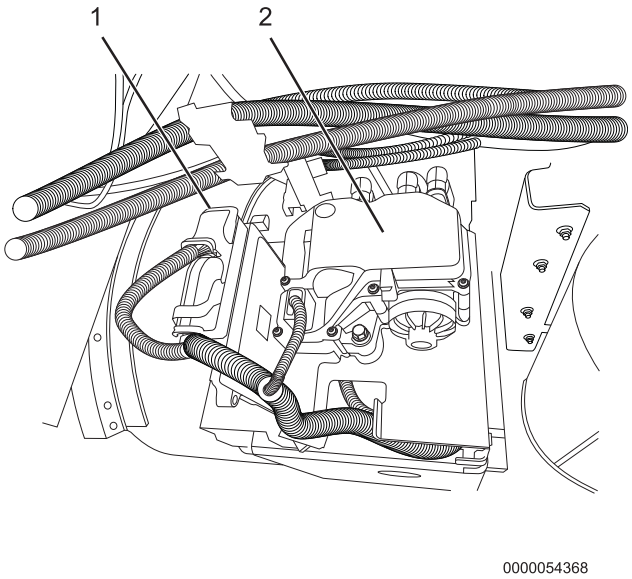


Figure 237 DEFRV Supply Module Location

1. Aftertreatment Control Module (ACM)
2. Diesel Exhaust Fluid (DEF) supply module

SPN 4376 FMI 3 - DEF Reverting Control Valve short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) voltage is above normal, shorted to high source, or open. High signal voltage is detected.	Resistance between the DEF: RCV CTL and DEF: RCV GND > 500,000 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) voltage is more than expected for 1 second. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

DEF: RCV is internal to Diesel Exhaust Fluid (DEF) supply module and is not serviceable individually. If fault is active, dosing system may not be able to purge, and DEF may be left in the lines. DEF remaining in lines can freeze and cause Selective Catalytic Reduction (SCR) system to become damaged in cold weather.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: RCV CTL circuit Open or high resistance
- DEF: RCV GND circuit Open or high resistance
- DEF: RCV CTL circuit short to PWR
- Failed DEF: RCV

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4376 FMI 3 DEF: RCV. Does EST DTC show SPN 4376 FMI 3 as Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.

Step 2	Inspect connections at Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEF: RCV sensor module connector. C. Check DEF: RCV sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: RCV sensor module connector, harness, and terminals clean and undamaged?		Go to Step 3 No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.

Step 3	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Disconnect ACM module connector. C. Check ACM connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.

Pin-Point Tests (SPN 4376 FMI 3)

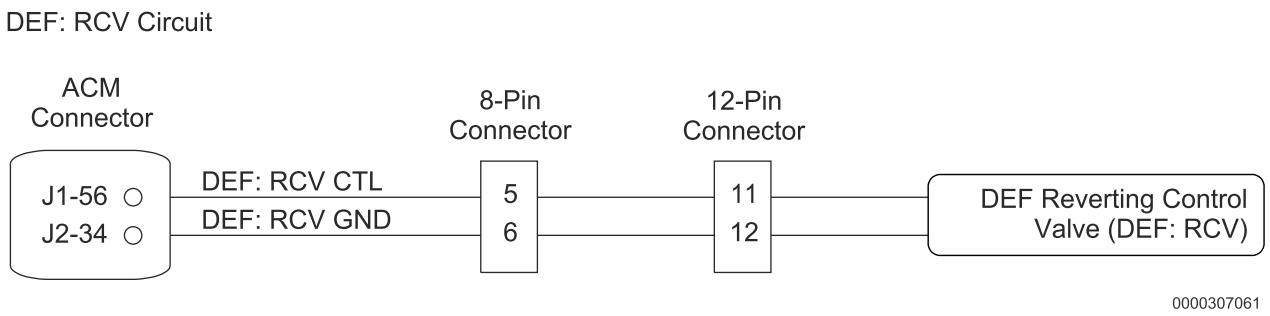


Figure 238 DEF: RCV Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- Breakout Harness 18-537-01
- Breakout Harness 18-909-01
- Digital Multimeter (DMM)

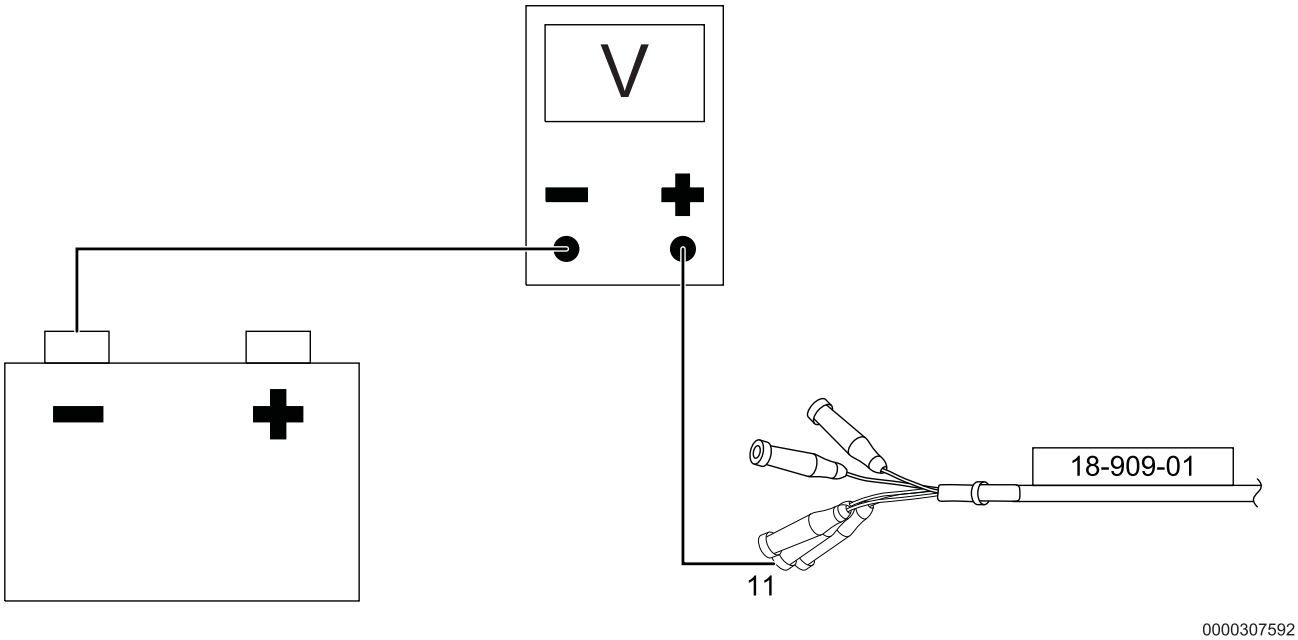
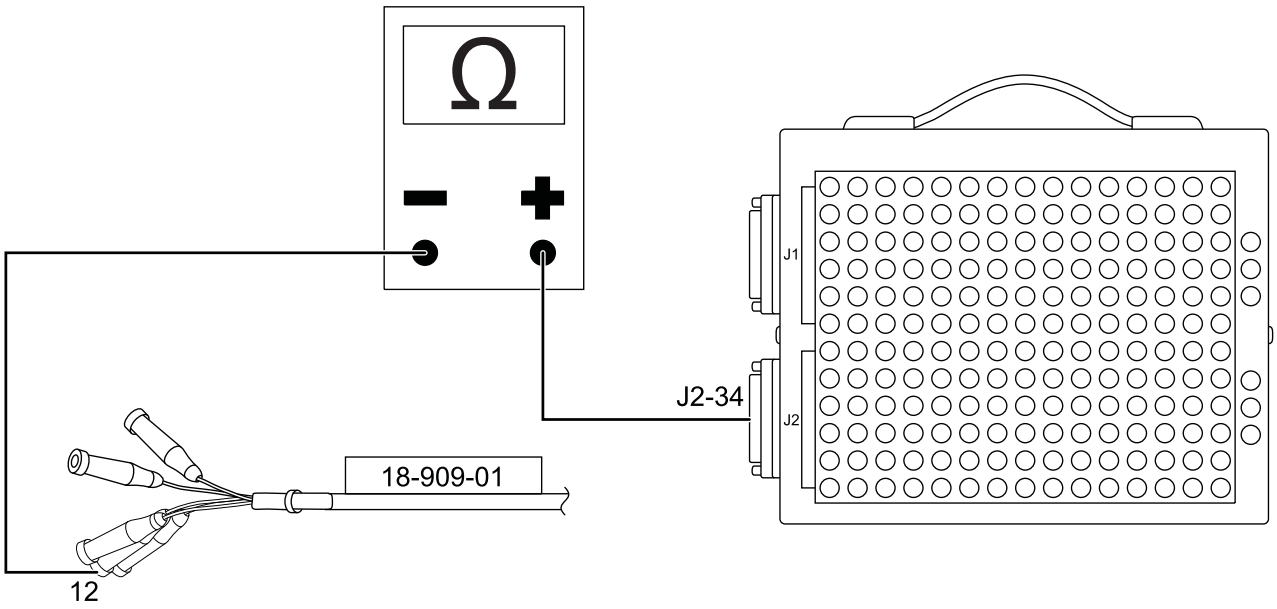


Figure 239 Test 1 DEF: RCV Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 between Diesel Exhaust Fuel (DEF) supply module and vehicle harness. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) pin-11 and a known good GND.	Less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Go to Test 2.
	No: Repair short to PWR in DEF: RCV CTL circuit between ACM pin J1-56 and DEF: RCV pin-11. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.



0000307601

Figure 240 Test 2 DEF: RCV Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect 180-pin Breakout Box 00-00956-08 with Breakout Harness 18-537-01 to Aftertreatment Control Module (ACM) vehicle harness, and leave ACM disconnected. C. Disconnect Breakout Harness 18-909-01 from Diesel Exhaust Fluid (DEF) supply module, and leave connected to vehicle harness. D. Key-ON.

Test 2	Specification
Use DMM to measure resistance from Breakout Harness 18-909-01 pin-12 and Breakout Box 00-00956-08 pin J2-34.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open or high resistance in DEF: RCV CTL circuit between ACM pin J1-56 and supply module pin-11. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.
	No: Repair Open or high resistance in DEF: RCV GND circuit between ACM pin J2-34 and supply module pin-12. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4376 FMI 3 fault code diagnostics.

SPN 4376 FMI 4 - DEF Reverting Control Valve short to GND

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) voltage is below normal, or shorted to low source. Low signal voltage is detected.	Resistance between DEF: RCV CTL and DEF: RCV GND circuits < 0.2 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid DEF: RCV voltage is less than expected value for 1 second. DEF injection into aftertreatment system is disabled. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

DEF: RCV is internal to the DEF supply module and is not serviceable individually. If fault is active, the dosing system may not be able to purge and DEF may be left in the lines. DEF lines can freeze and cause the Selective Catalytic Reduction (SCR) system to become damaged in cold weather.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: RCV CTL circuit short to GND
- DEF: RCV CTL shorted to DEF: RCV GND
- Failed DEF: RCV

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4376 FMI 4 (DEF: RCV). Is EST DTC list SPN 4376 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 4.

Step 2	Inspect connections at Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEF: RCV sensor module connector. C. Check DEF: RCV sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DEF: RCV sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 4.

Pin-Point Tests (SPN 4376 FMI 4)

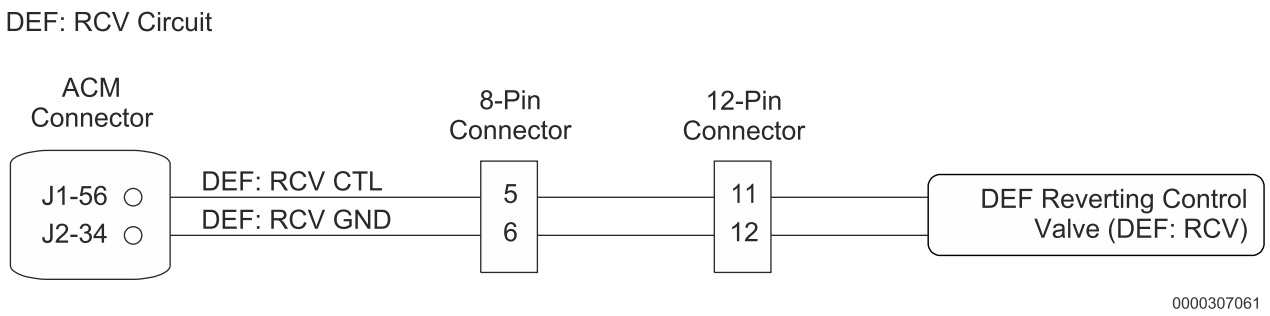
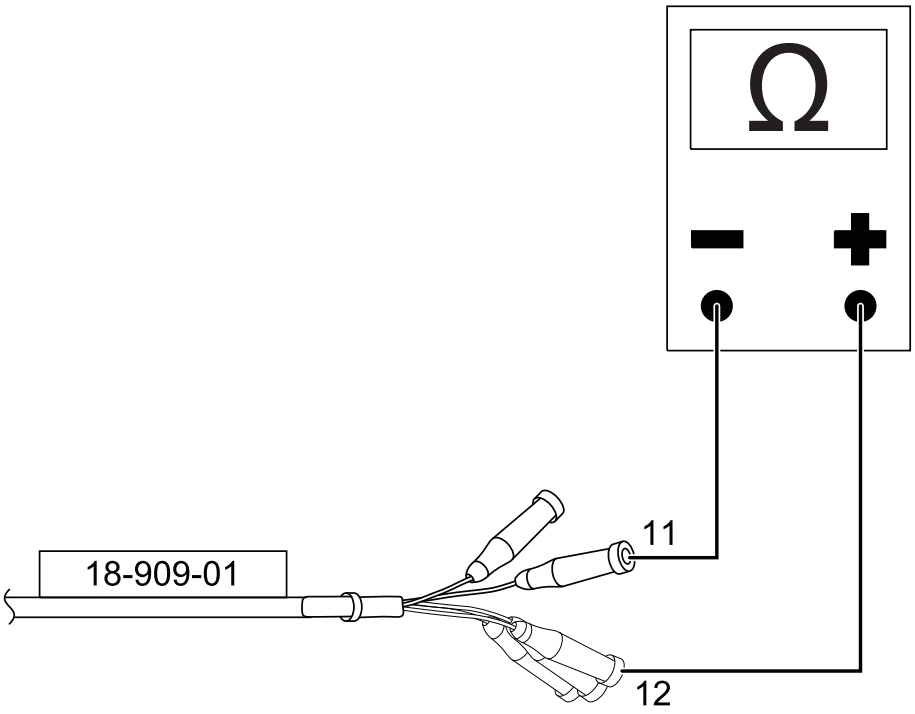


Figure 241 DEF: RCV Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-909-01
- Digital Multimeter (DMM)

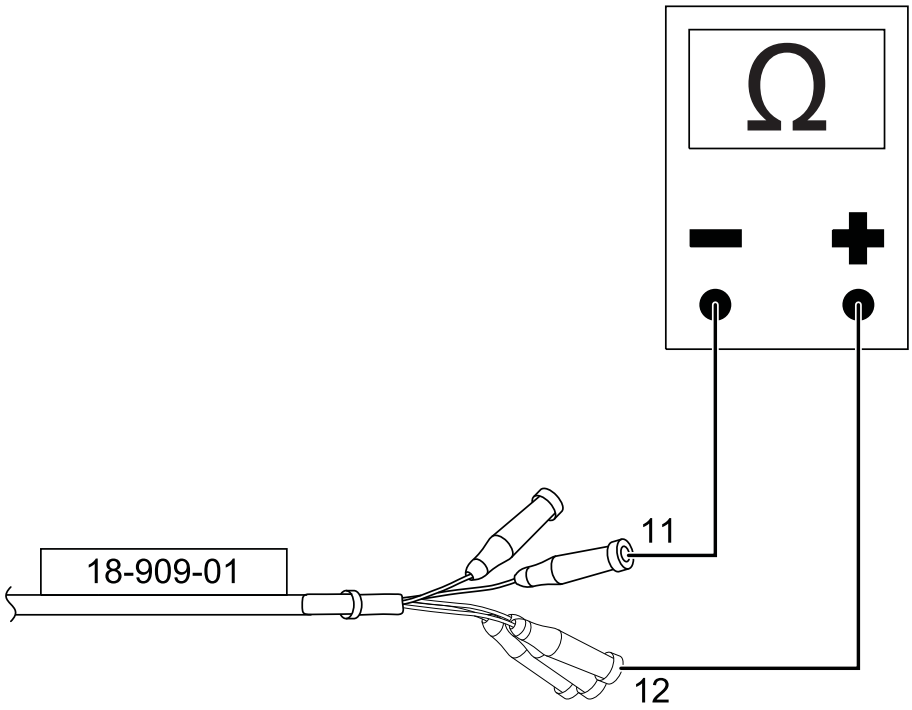


0000308190

Figure 242 Test 1 DEF: RCV Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to Diesel Exhaust Fuel (DEF) supply module and leave vehicle harness disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-11 and pin-12.	Greater than 5 ohms
Decision	
Is resistance greater than 5 ohms?	Yes: Go to Test 2.
	No: Replace DEF supply module. After repairs are complete, retest for SPN 4376 FMI 4.



0000308190

Figure 243 Test 2 DEF: RCV Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to vehicle harness and leave DEF supply module disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure resistance from Breakout Harness 18-909-01 pin-11 and pin-12.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to GND between DEF supply module pin-11 and Aftertreatment Control Module (ACM) pin J1-56. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4376 FMI 4.
	No: Repair short between DEF: RCV CTL and DEF: RCV GND circuits. After repairs are complete, retest for SPN 4376 FMI 4

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4376 FMI 4 fault code diagnostics.

SPN 4376 FMI 7 - DEF Reverting Control Valve - Mechanical system not responding or out of adjustment

Condition / Description	Setting Criteria	Enable Conditions / Values
The DEF: RCV is commanded open, but the DEF doser pressure does not drop as expected.	The DEF supply module pressure after the return valve is opened for 5 seconds > 72.5 psi (500 kPa)	Key ON DEF supply pump command ≥ 5 % (pump ON) DEF supply module pressure sampled when the return valve was opened > 101.5 psi (700 kPa) DEF: RCV commanded ON The following fault codes must be inactive: SPN 3361 FMI 3, 4 (DEF: SP); SPN 4334 FMI 2, 3, 4 (DEF: AP); SPN 4376 FMI 3, 4 (DEF: RCV)

Fault Overview

The fault code sets when the Aftertreatment Control Module (ACM) detects that the Diesel Exhaust Fluid Return Valve (DEF: RCV) is commanded open, but the DEF doser pressure does not drop as expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4334 FMI 2, 3, 4, 16, and 18 (DEF: AP)	• SPN 4376 FMI 3 and 4 (DEF: RCV)		

Fault Fact

The DEF: RCV is internal to the DEF supply module and is not serviceable individually. If fault is active, the dosing system may not be able to purge, and DEF may be left in the lines. DEF lines can freeze and cause the Selective Catalytic Reduction (SCR) system to become damaged in cold weather.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted DEF return line or fittings, or incorrect connections
- Restriction in DEF tank
- Failed DEF: RCV

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check for Associated Faults(page 675). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4376 FMI 7.

Step 2	Check Diesel Exhaust Fluid (DEF) supply module return line for restrictions.	Decision
Disconnect both ends of return line and blow compressed air through the line. Does compressed air flow freely through the return line?		Yes: Go to Step 3. No: Clean or replace DEF supply module return line. After repairs are complete, retest for SPN 4376 FMI 7.

Step 3	Check DEF tank and tank vent.	Decision
Check Diesel Exhaust Fluid (DEF) tank for debris, foreign particles, or ice. Also check DEF tank vent for restrictions or fluid crystallization. Are the DEF tank and DEF tank vent clean and free of debris, restrictions, and fluid crystallization?		Yes: Replace DEF supply module. After repairs are complete, retest for SPN 4376 FMI 7. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. Clean DEF supply module using 18-200-01. After repairs are complete, retest for SPN 4376 FMI 7.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4376 FMI 7 fault code diagnostics.

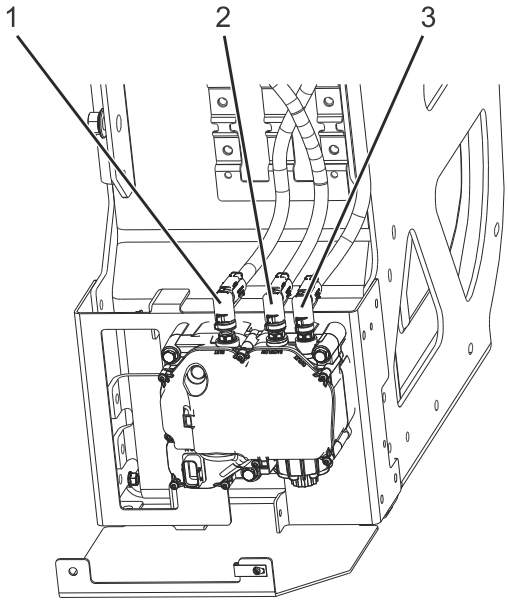
DEFPLH (Diesel Exhaust Fluid Pressure Line Heater)

Overview of DEFPLH Sensor Group

SPN	FMI	Description
4344	3	DEF Pressure Line Heater Short to PWR (page 678)
4344	5	DEF Pressure Line Heater open load/circuit (page 684)

Overview

Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) is used to maintain proper Diesel Exhaust Fluid (DEF) temperature during cold conditions. DEFPLH is wrapped around supply line between DEF tank and DEF supply module. When DEF temperature is too low, Aftertreatment Control Module (ACM) turns on Diesel Exhaust Fluid Return Line Heater (DEFRLH) allowing power to be sent to DEFPLH.



0000054407

Figure 244 DEFPLH Sensor Location

1. DEFSLH
2. DEFRLH
3. Diesel Exhaust Fluid Pressure Line Heater (DEFPLH)

SPN 4344 FMI 3 - DEF Pressure Line Heater Short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) current is greater than expected.	DEFPLH current > 0.5 amp	Key ON The Diesel Exhaust Fluid Line Heater Relay is turned OFF

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) is greater than 0.5 amp for 3 seconds. Engine torque will be reduced, and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 DEF Line Heater Relay			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and Diesel Exhaust Fluid Supply Line Heater (DEFSLH) share a common power circuit. If more than one DEF line heater fault is set, suspect a common power circuit problem.

Possible Causes

- DEFPLH circuit short to PWR
- DEFPLH power circuit shorted to PWR between Diesel Exhaust Fluid Line Heater Relay pin-87 and DEFPLH pin-1
- Failed DEF Line Heater Relay

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 678).		Yes: Go to Step 2.
Is EST DTC free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4344 FMI 3.

Step 2	Inspect connections at Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEFPLH connector. C. Check DEFPLH and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are DEFPLH connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4344 FMI 3.

Step 3	Check DEFPLH Voltage.	Decision
Perform Test 1(page 681). Use DMM to measure voltage between Breakout Harness 18-047-01 pin-1 and known good ground.		Yes: Retest for SPN 4340 FMI 3.
Is voltage less than or equal to 0.5 volt?		No: Go to Step 4.

Step 4	Check DEFPLH Voltage.	Decision
Perform Test 2(page 683). Use DMM to measure voltage between Breakout Harness 18-047-01 pin-1 and known good ground.		Yes: Replace the DEF Line Heater Relay. After repairs are complete, retest for SPN 4344 FMI 3.
Is voltage less than or equal to 0.5 volt?		No: Repair short to PWR between PDM terminal 87 for DEF Line Heater Relay and DEFPLH connector pin-2. After repairs are complete, retest for SPN 4344 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4344 FMI 3 fault code diagnostics.

Pin-Point Tests (SPN 4344 FMI 3)

DEF Line Heater Relay Circuit

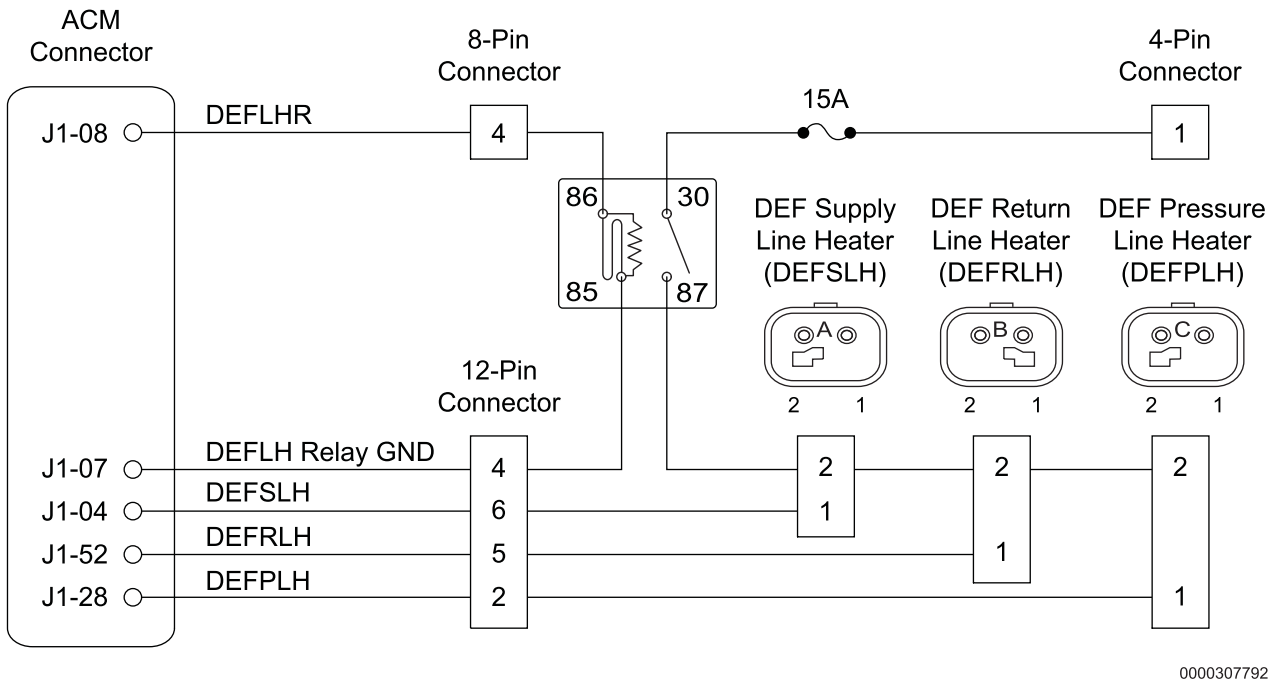


Figure 245 Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-047-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

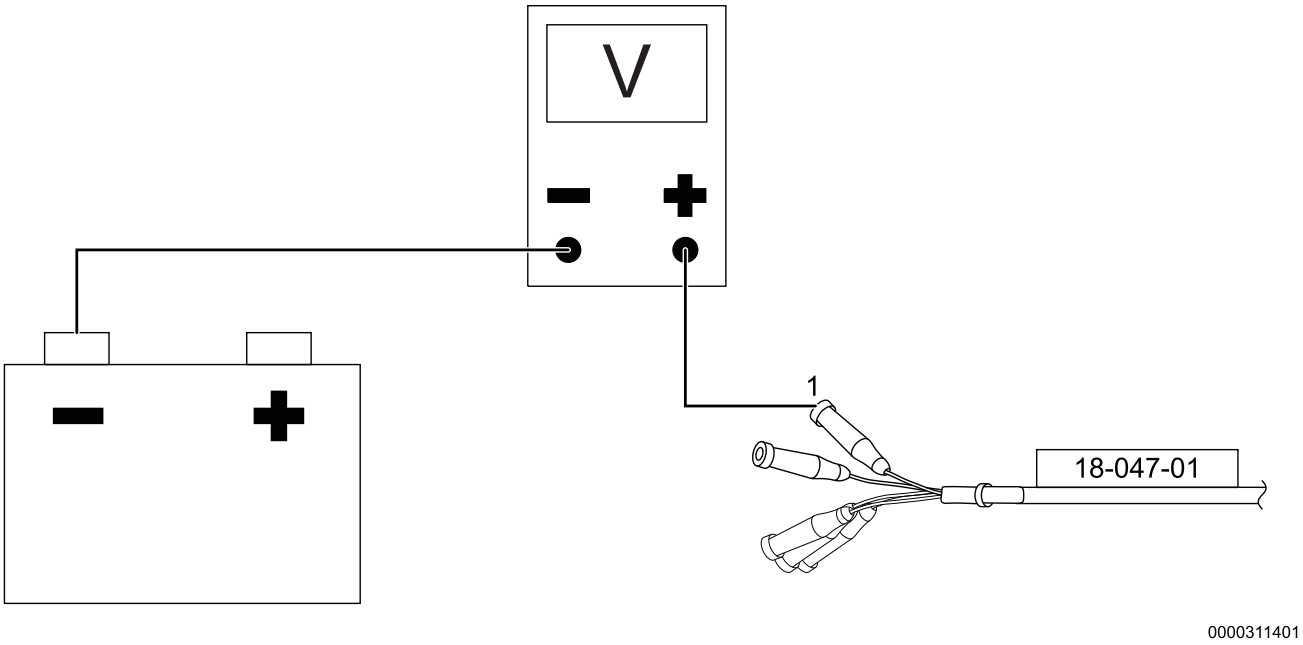


Figure 246 Test 1 DEFPLH Voltage Check

Test 1
A. Key OFF.
B. Disconnect Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) vehicle harness connector.
C. Connect Breakout Harness 18-047-01 to vehicle harness connector and leave DEFPLH disconnected.
D. Key ON.

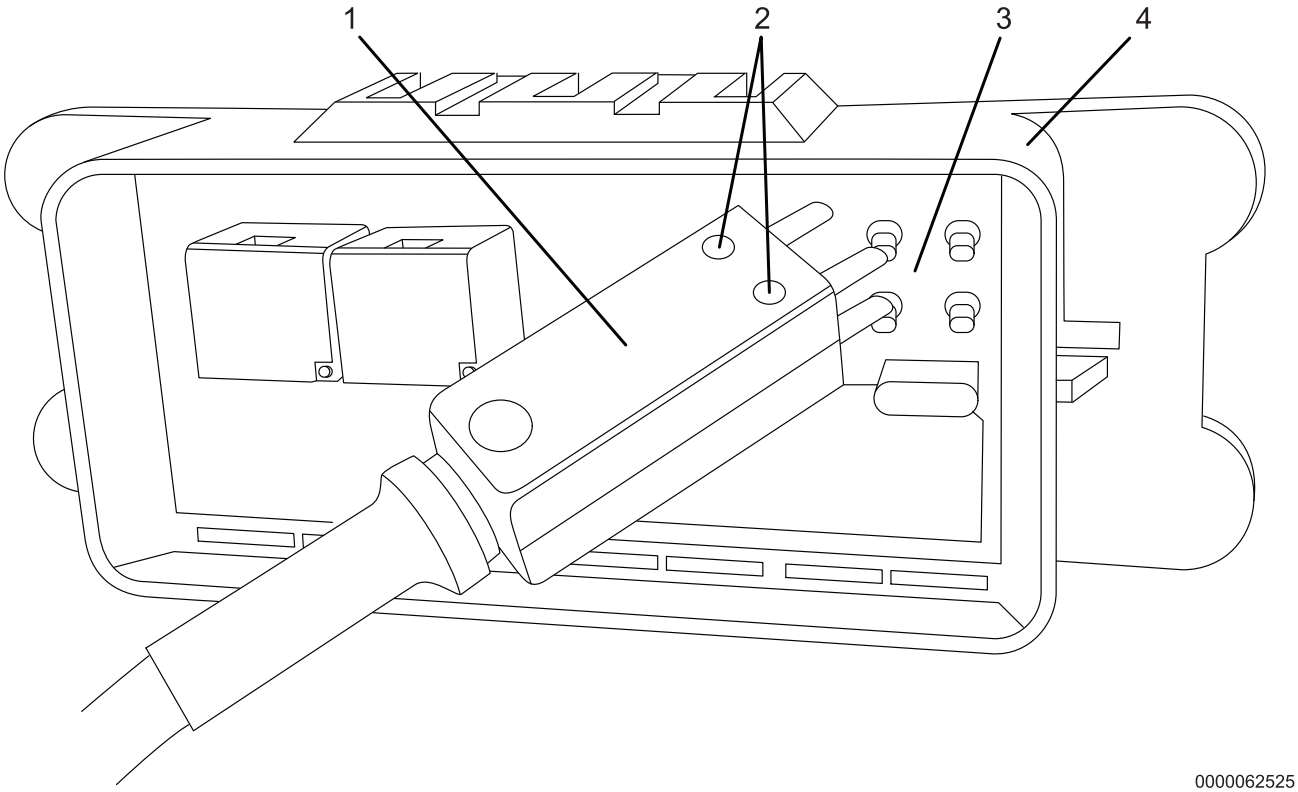


Figure 247 Installation of Breakout Harness ZTSE4908 (Typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with the dimples toward the top of the Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

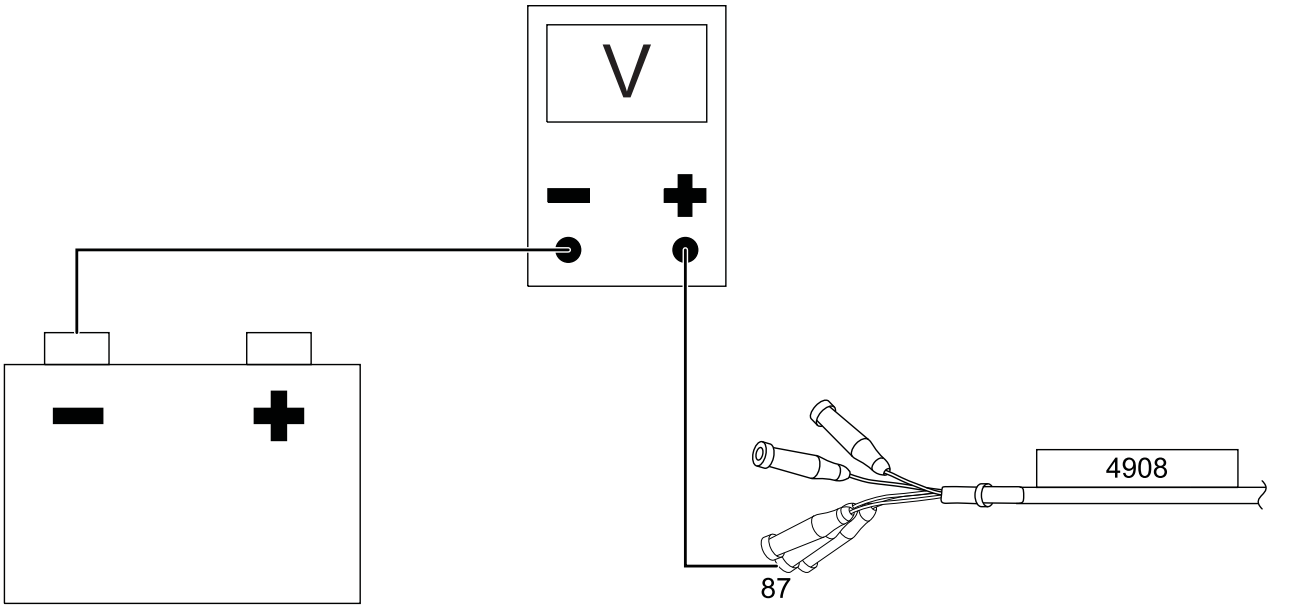


Figure 248 Test 2 DEFPLH Voltage Check

Test 2
A. Key OFF.
B. Remove Diesel Exhaust Fluid Line Heater Relay.
C. Install Breakout Harness ZTSE4908 and leave relay disconnected.
D. Key ON.

SPN 4344 FMI 5 - DEF Pressure Line Heater open load/circuit

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) circuit open. Current less than expected.	DEFPLH current > 0.3 amps	Key ON The Diesel Exhaust Fluid Line Heater Relay is turned ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects current from Diesel Exhaust Fluid Pressure Line Heater (DEFPLH) is less than 0.3 amps. Engine torque will be reduced and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5491 (DEFLH Relay)			

Fault Facts

Diesel Exhaust Fluid Return Line Heater (DEFRLH), Diesel Exhaust Fluid Pressure Line Heater (DEFPLH), and Diesel Exhaust Fluid Supply Line Heater (DEFSLH) share a common power circuit. If more than one Diesel Exhaust Fluid (DEF) line heater fault is set, suspect a common power circuit problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEFPLH
- DEFPLH circuit open or high resistance
- DEFPLH circuit short to ground (GND)
- DEFPLH power circuit open or high resistance
- DEFPLH power circuit short to GND
- Blown fuse or open power circuit to DEFLH Relay
- Failed DEFLH Relay

Verify batteries are fully charged and connections are clean.

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 684). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4344 FMI 5.

Step 2	Inspect connections at DEFPLH connector.	Decision
A. Key OFF. B. Disconnect DEFPLH connector. C. Check DEFPLH and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEFPLH connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4344 FMI 5.

Pin-Point Tests (SPN 4344 FMI 5)

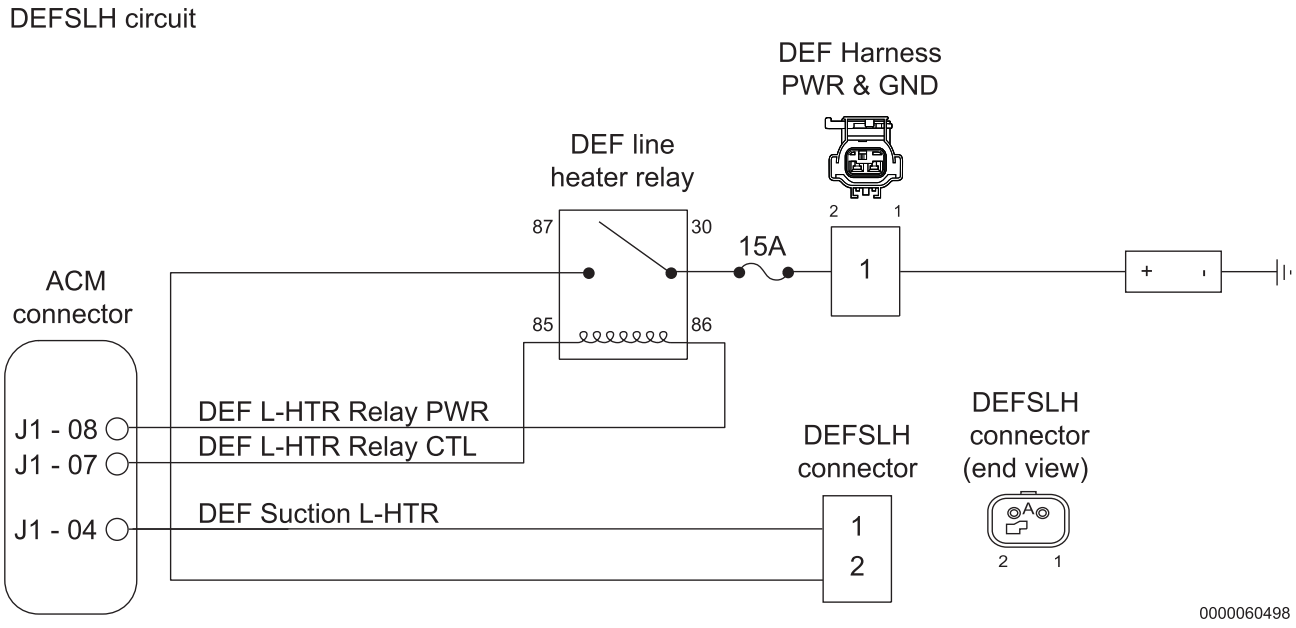


Figure 249 DEFPLH Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-045-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

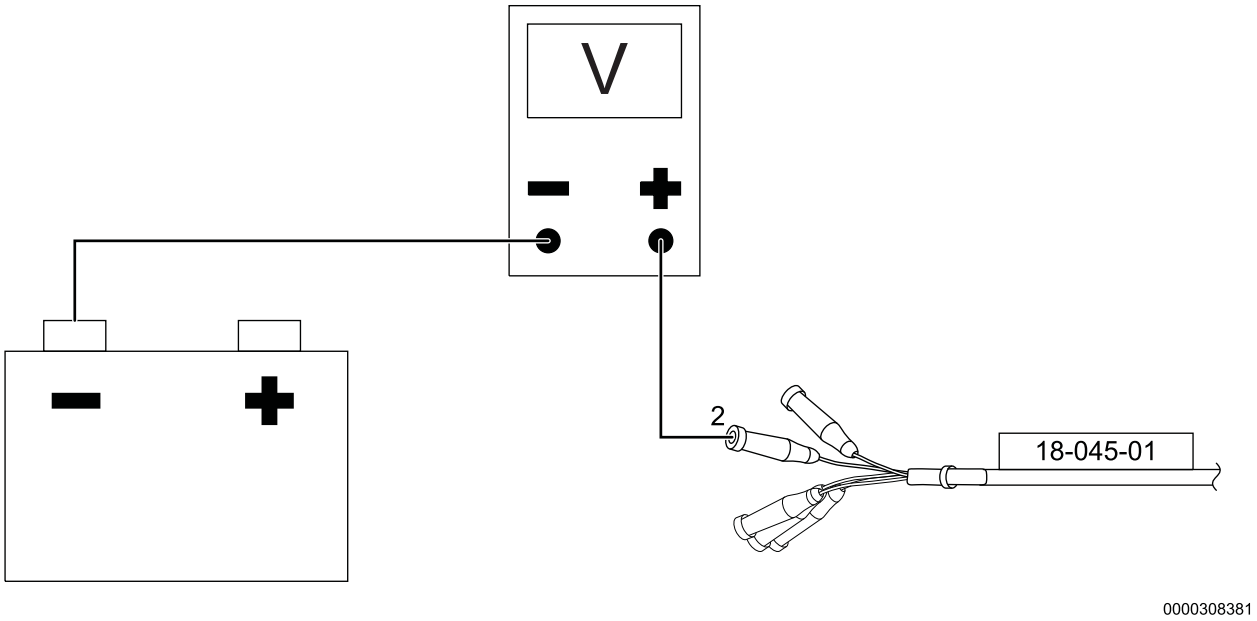


Figure 250 Test 1 DEFPLH Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect DEFPLH vehicle harness connector. C. Connect Breakout Harness 18-045-01 to vehicle harness connector and leave DEFPLH disconnected. D. Key ON.

Test 1	Specification
Using Electronic Service Tool (EST) with ServiceMaxx™ software, select Tests > KOEO Aftertreatment Tests > KOEO DEF Line Heater Test(page 2161). Run test and measure voltage between Breakout Harness 18-045-01 pin-2 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 7.
	No: Go to Test 2.

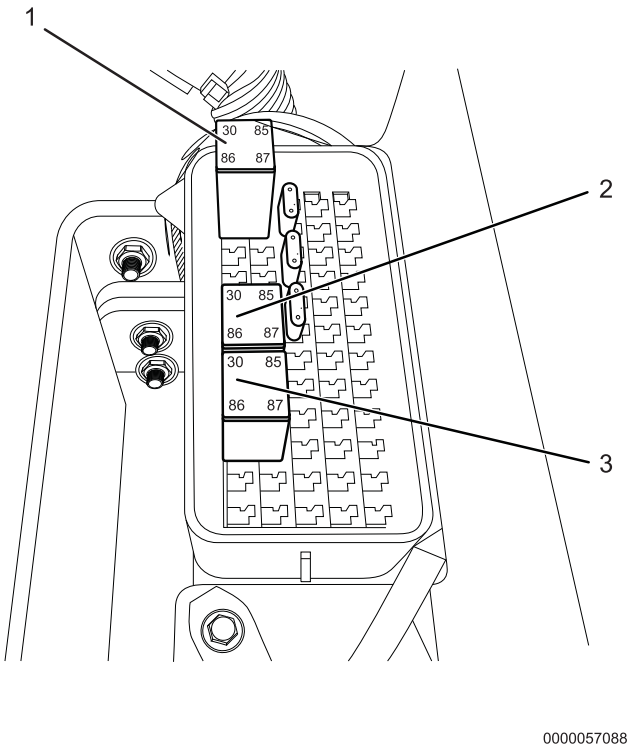


Figure 251 Power Distribution Module (PDM) Fuses and Relays

1. DEF: LHR
2. Diesel Exhaust Fluid Supply Module Heater Relay (DEF: SMH Relay)
3. Switched ignition relay

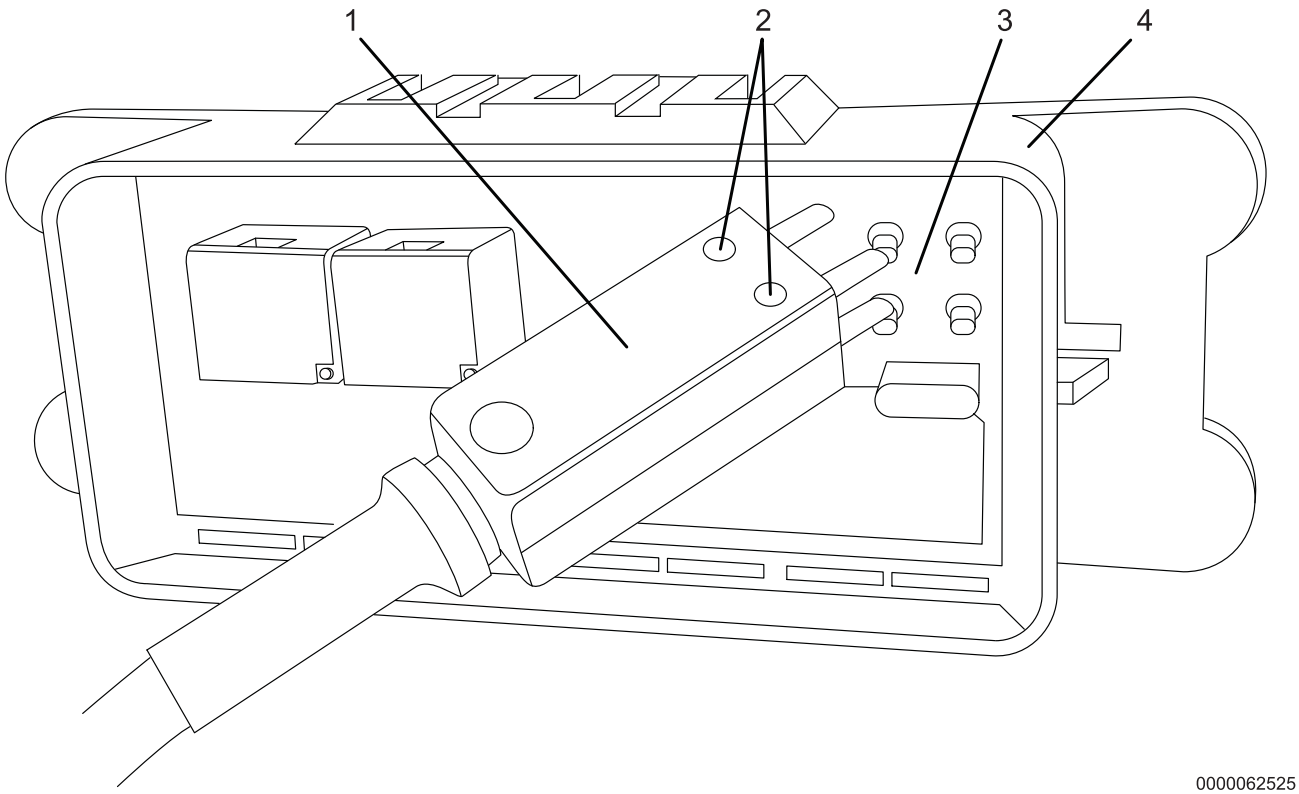


Figure 252 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with the dimples toward the top of the Power Distribution Module (PDM). Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF. B. Remove DEF: LHR. C. Install Breakout Harness ZTSE4908 and leave relay disconnected. D. Key ON.

Test 2	Specification
Connect test light between Breakout Harness ZTSE4908 pin-30 and known good ground.	Test light illuminates, DEF: LHR fuse is not blown
Decision	
Does test light illuminate and is DEF: LHR 15-amp fuse in good condition and not blown?	Yes: Go to Test 6.
	No: Go to Test 3.

Test 3 Setup
A. Key OFF. B. Remove DEF: LHR. C. Install Breakout Harness ZTSE4908 and leave relay disconnected. D. Key-On Engine-Off (KOEO).

Test 3	Specification
Use DMM to check for voltage between vehicle side of DEF: LHR 15-amp fuse and a known good ground.	Within 0.5 volt of B+
Decision	
Is voltage within 0.5 volt of B+?	Yes: Go to Test 4.
	No: Repair Open or high resistance between DEF: LHR 15-amp fuse and vehicle PWR. After repairs are complete, retest for SPN 4344 FMI 5.

Test 4 Setup
A. Key OFF. B. Disconnect DEFPLH. C. Install Breakout Harness ZTSE4908 and leave relay disconnected. D. Key-On Engine-Off (KOEO).

Test 4	Specification
Remove and replace DEF: LHR 15–amp fuse.	New fuse does not blow when replaced
Decision	
Does the DEF: LHR 15-amp fuse blow when replaced?	Yes: Repair short to ground (GND) between DEF: LHR 15-amp fuse and DEF: LHR pin-30. After repairs are complete, retest for SPN 4344 FMI 5.
	No: Go to Test 5.

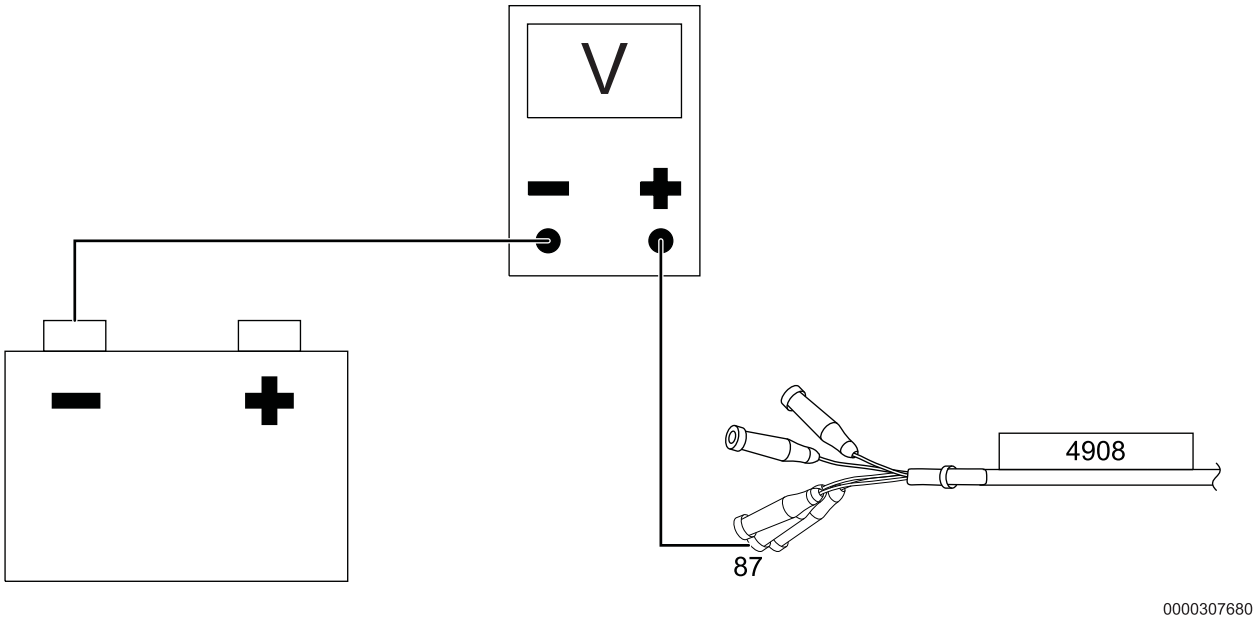


Figure 253 Test 5 DEF: LHR Short Check

Test 5 Setup
A. Key OFF. B. Install DEF: LHR. C. Install Breakout Harness ZTSE4908 and leave relay disconnected. D. Key-On Engine-Off (KOEO).

Test 5	Specification
Using Electronic Service Tool (EST) with ServiceMaxx™ software, select Tests > KOEO Aftertreatment Tests > KOEO DEF Line Heater Test(page 2161). Run test and check for short to ground between Breakout Harness ZTSE4908 pin-87 and DEF: SLH.	New fuse does not blow when line heaters are turned on
Decision	
Does the DEF: LHR 15-amp fuse blow when line heaters are turned ON?	Yes: Repair short to ground (GND) between DEF: LHR pin-87 and DEFPLH, Diesel Exhaust Fluid Supply Line Heater (DEFSLH), or Diesel Exhaust Fluid Return Line Heater (DEFRLH). After repairs are complete, retest for SPN 4344 FMI 5.
	No: Repair open or high resistance between DEF: LHR pin-87 and DEFSLH, DEFPLH, or DEFRLH. After repairs are complete, retest for SPN 4344 FMI 5.

Test 6 Setup
A. Key OFF. B. Remove DEF: LHR. C. Install Breakout Harness 18-045-01 and leave DEFPLH sensor disconnected. D. Connect Breakout Harness ZTSE4908 to PDM. E. Key-On Engine-Off (KOEO).

Test 6	Specification
Using DMM, measure resistance between Breakout Harness ZTSE4908 pin-87 and Breakout Harness 18-045-01 pin-2.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF: LHR. After repairs are complete, retest for SPN 4344 FMI 5.
	No: Repair open or high resistance between DEFPLH pin-2 and DEF: LHR pin-87. After repairs are complete, retest for SPN 4344 FMI 5.

Test 7 Setup
A. Key OFF. B. Disconnect ACM.

Test 7	Specification
Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.	Terminals are undamaged
Decision	
Are ACM connector, harness, and terminals clean and undamaged?	Yes: Go to Test 8.
	No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4344 FMI 5.

Test 8 Setup
A. Key OFF. B. Disconnect DEFPLH vehicle harness connector. C. Connect 180-pin Breakout Box 18-537-01 to vehicle harness and leave ACM disconnected. D. Connect Breakout Harness 18-045-01 to vehicle harness.

Test 8	Specification
Using DMM, measure resistance between Breakout Harness 18-537-01 pin J1-04 and Breakout Harness 18-045-01 pin-1.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 9.
	No: Repair open or high resistance between ACM connector pin J1-04 and DEFPLH connector pin-1. After repairs are complete, retest for SPN 4344 FMI 5.

Test 9 Setup
A. Key OFF. B. Disconnect DEFPLH vehicle harness connector. C. Connect Breakout Harness 18-045-01 to vehicle harness connector and leave DEFPLH disconnected.

Test 9	Specification
Using DMM, measure resistance between Breakout Harness 18-045-01 pin-1 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Replace DEF: SLH. After repairs are complete, retest for SPN 4344 FMI 5.
	No: Repair short to ground (GND) between ACM connector pin J1-04 and DEFPLH connector pin-1. After repairs are complete, retest for SPN 4344 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to 4344 FMI 5 fault code diagnostics.

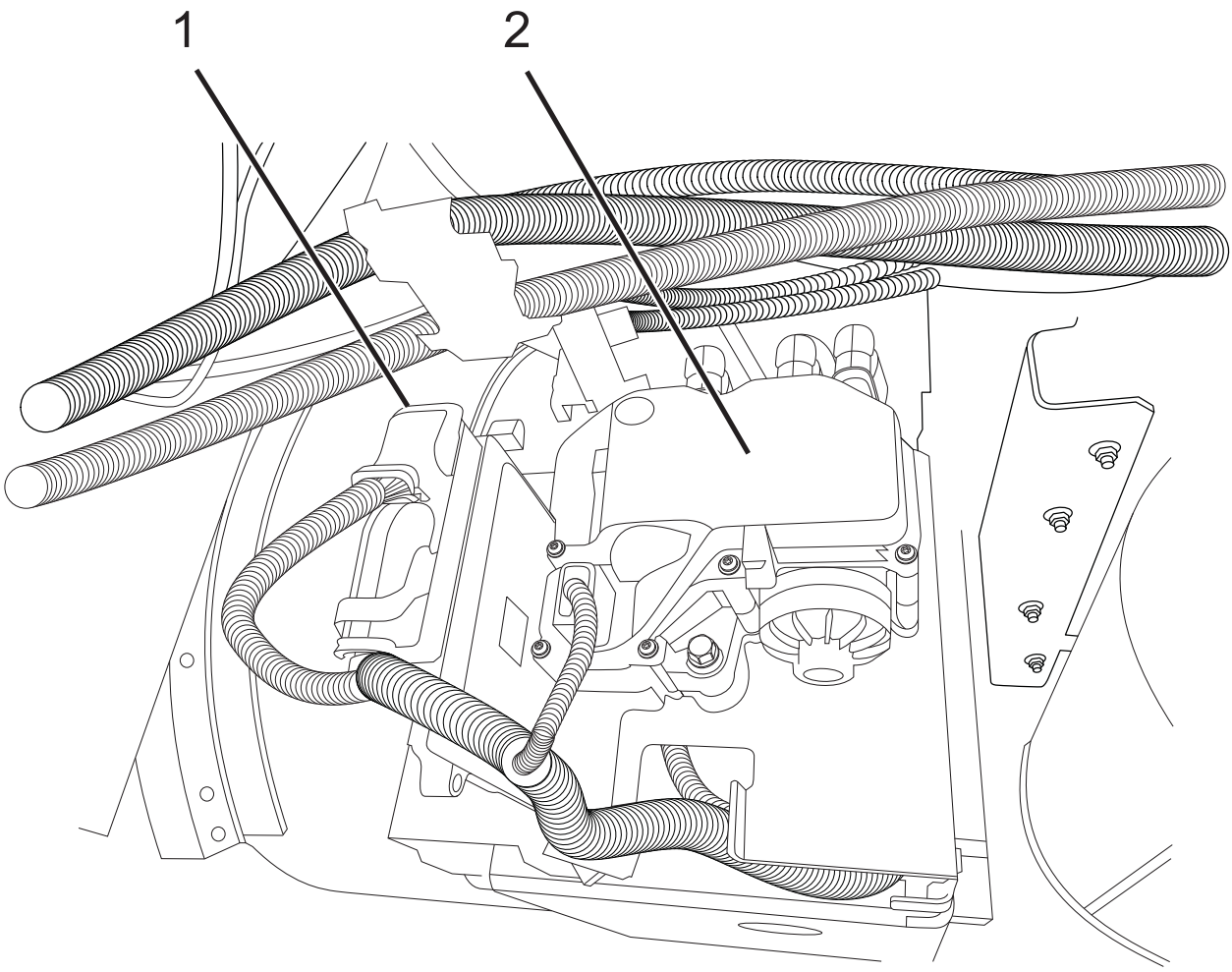
DEF: SP (Diesel Exhaust Fluid Supply Pump)

Overview of DEF: SP Sensor Group

SPN	FMI	Description
3361	2	DEFSP signal erratic, intermittent or incorrect (page 700)
3361	3	DEFSP signal Out of Range HIGH (page 708)
3361	4	DEFSP signal Out of Range LOW (page 713)
3362	31	DEF dosing unable to prime (page 722)

Overview

Diesel Exhaust Fluid Supply Pump (DEF: SP) is controlled using a PWM signal from Aftertreatment Control Module (ACM). DEF: SP is installed in DEF Supply Module and is a non-serviceable component. DEF Supply Module has an internal temperature sensor used to monitor DEF: SP temperature. When DEF: SP temperature is too high, ACM will deactivate DEF: SP.



0000054368

Figure 254 DEF: SP Sensor Location

1. Aftertreatment Control Module (ACM)
2. Diesel Exhaust Fluid (DEF) supply module

SPN 3361 FMI 2 - DEFSP Signal Erratic, Intermittent or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Loss of communication or invalid data from Diesel Exhaust Fluid Supply Pump (DEF: SP).	Aftertreatment Control module (ACM) loses J1939 CAN data link communications with DEF: SP or DEF: SP temperature erratic	Key ON Supply module in temperature feedback mode

Fault Overview

Fault code sets when Diesel Exhaust Fluid Supply Pump (DEF: SP) temperature is not communicating with Aftertreatment Control Module (ACM) or DEF: SP temperature signal is erratic. Diesel Exhaust Fluid (DEF) injection into exhaust system is disabled, and engine torque is reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3361 FMI 3 and 4 (DEF: SP)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Exhaust Fluid (DEF) supply module
- Diesel Exhaust Fluid Supply Pump (DEF: SP) Temp / Control circuit high resistance
- DEF: SP Temp / CTL circuit intermittent short to GND
- DEF: SP ground circuit high resistance
- Power Distribution Module (PDM) loose fuse or relay

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 700). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3361 FMI 2.

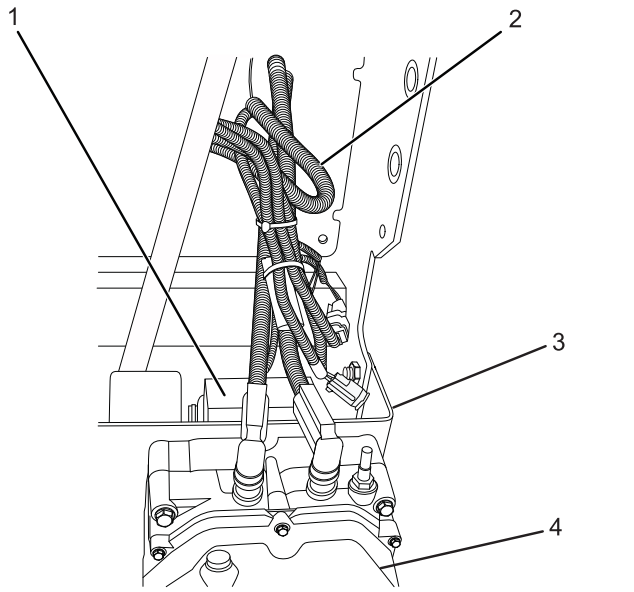


Figure 255 PDM Location (typical)

1. PDM
2. DEF tank assembly
3. DEF supply module bracket
4. DEF supply module

Step 2	Inspect Power Distribution Module (PDM).	Decision
A. Key OFF. B. Disconnect PDM connector. C. Check PDM fuse(s) and relay(s) for blown fuses and loose, missing, or intermittent connections. Are PDM fuses and relays securely attached and in good condition?		Yes: Go to Step 3. No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 3361 FMI 2.

Step 3	Inspect connections at Diesel Exhaust Fluid (DEF) supply module.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF supply module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3361 FMI 2.

Step 4	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Disconnect ACM connector. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3361 FMI 2.

Pin-Point Tests (SPN 3361 FMI 2)

DEF: SP and Temperature Sensor Circuit

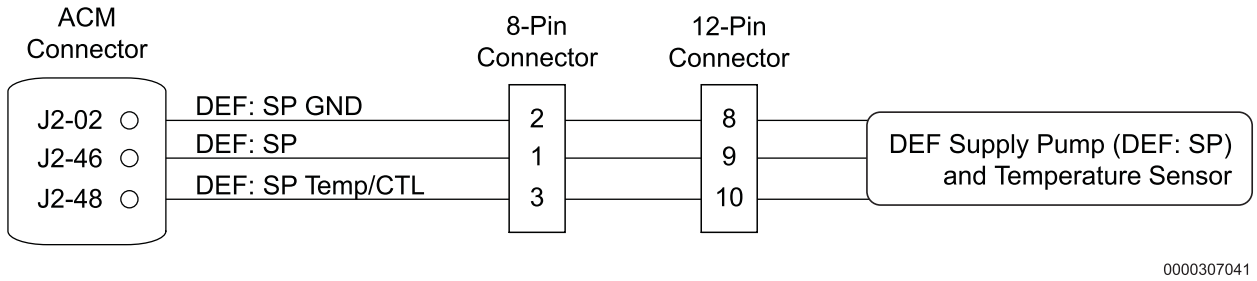


Figure 256 Diesel Exhaust Fluid Supply Pump (DEF: SP) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-909-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

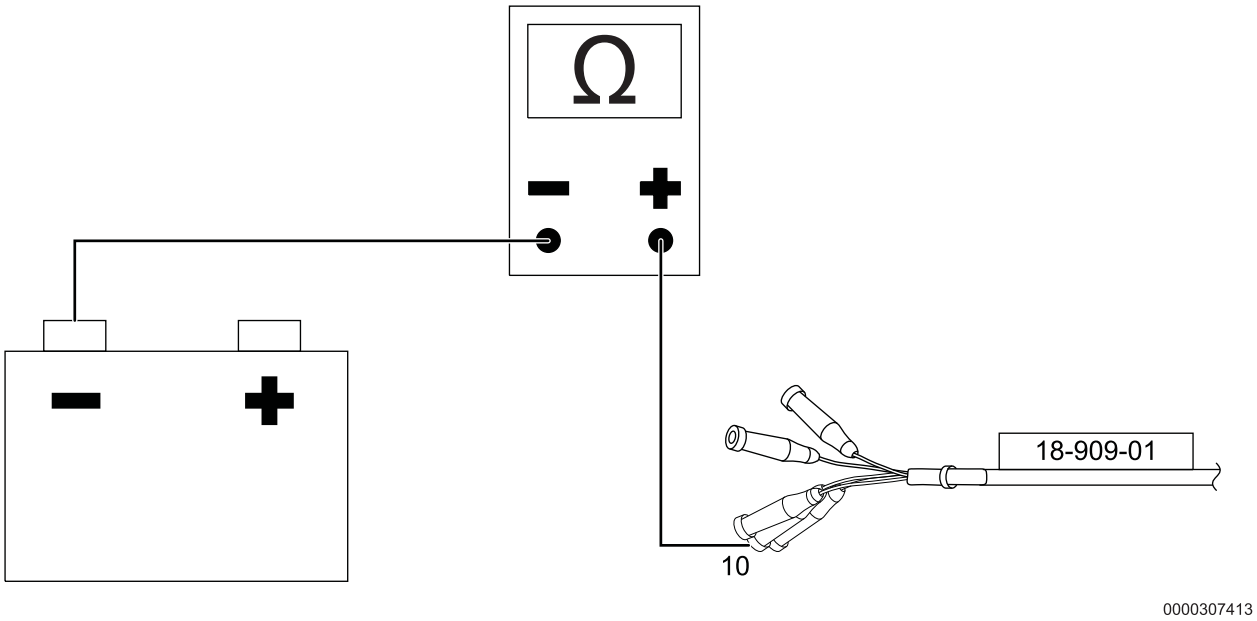


Figure 257 Test 1 Diesel Exhaust Fluid Supply Pump (DEF: SP) Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave supply module disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair intermittent short to ground between DEF supply module connector pin-10 and ACM connector J2 pin-48. After repairs are complete, retest for SPN 3361 FMI 2.

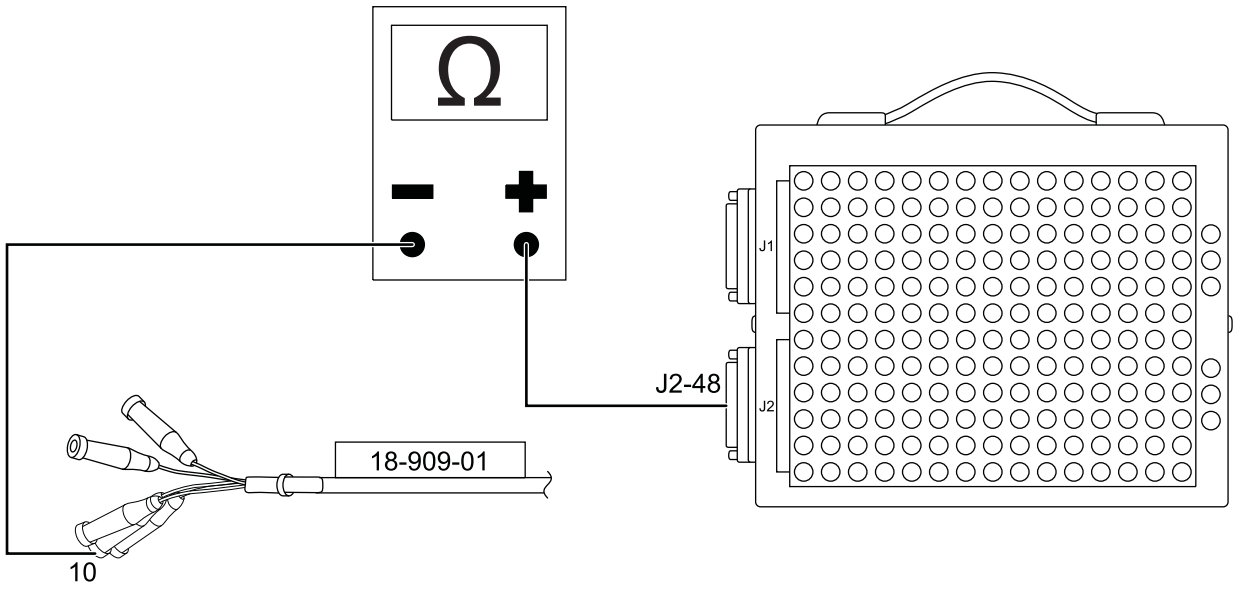


Figure 258 Test 2 Diesel Exhaust Fluid Supply Pump (DEF: SP) Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave supply module disconnected. C. Connect 180-pin Breakout Box with Breakout Harness 18-537-01 and ACM vehicle harness connector and leave module disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and 180-pin Breakout Box pin J2-48.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3.
	No: Repair high resistance between DEF supply module pin-10 and ACM connector J2 pin-48. After repairs are complete, retest for SPN 3361 FMI 2

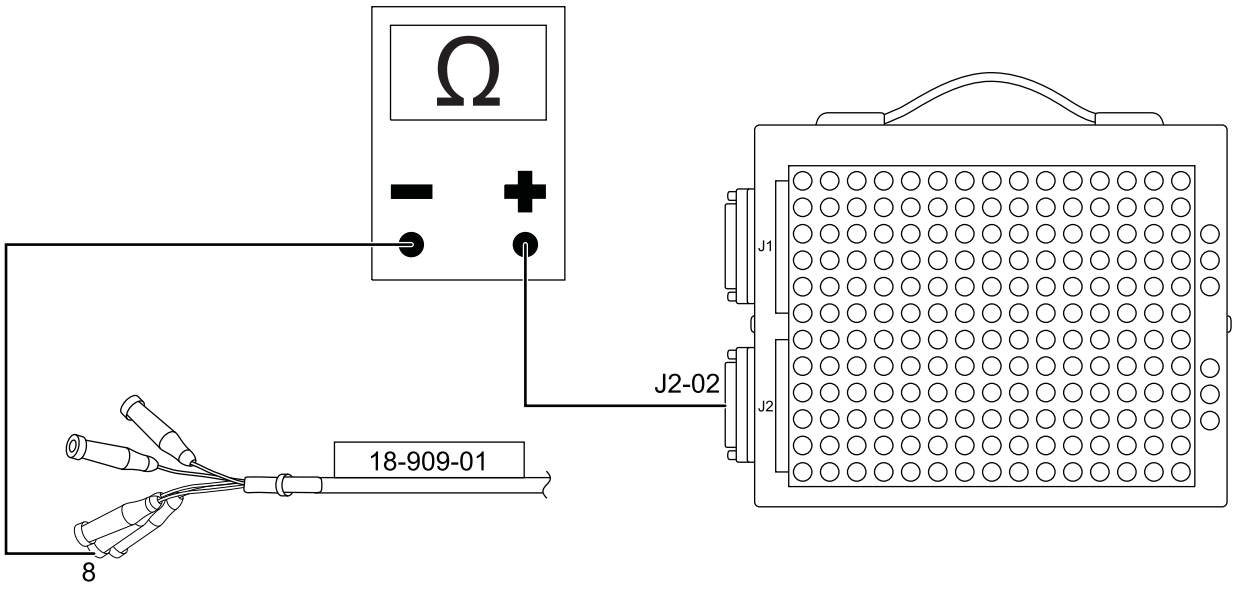


Figure 259 Test 3 Diesel Exhaust Fluid Supply Pump (DEF: SP) Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave supply module disconnected. C. Connect 180-pin Breakout Box with Breakout Harness 18-537-01 to ACM and leave module disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 18-909-01 pin-8 and 180-pin Breakout Box pin J2-02.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, retest for SPN 3361 FMI 2.
	No: Repair high resistance between DEF supply module pin-8 and ACM connector J2 pin-2. After repairs are complete, retest for SPN 3361 FMI 2

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3361 FMI 2 fault code diagnostics.

SPN 3361 FMI 3 - DEFSP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
DEF: SP Temp/CTL circuit voltage signal is above normal, shorted to high source, or open.	DEF: SP Temp/CTL circuit voltage signal > 8.5 volts	DEF pump motor command is ON System has passed DEF supply module temperature reading phase, and started controlling DEF pump motor DEF supply module power channel is ON DEF supply module power command is OFF

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects voltage signal from Diesel Exhaust Fluid Supply Pump (DEF: SP) is too high. DEF injection into the exhaust system is disabled and engine torque is reduced if fault is active for 4 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SP Temp/CTL circuit short to PWR
- DEF: SP GND circuit Open or high resistance
- Failed DEF supply module

Step1	Inspect connections at DEF supply module connector.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3361 FMI 3.

Pin-Point Tests (SPN 3361 FMI 3)

DEF: SP and Temperature Sensor Circuit

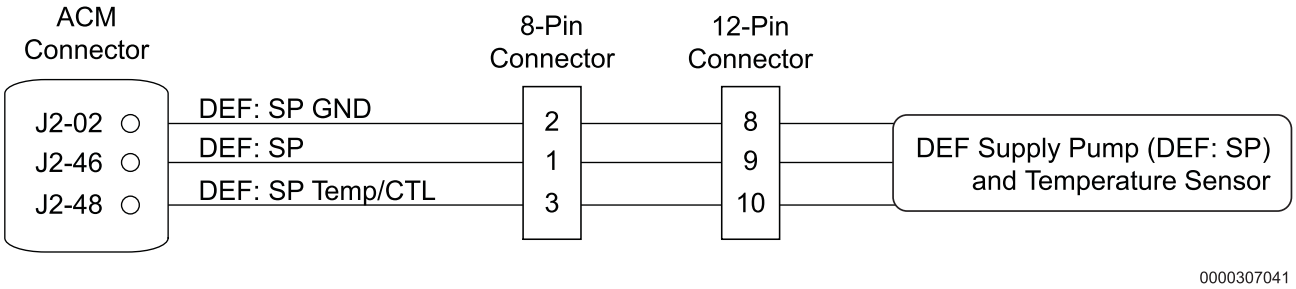


Figure 260 DEF: SP Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- Breakout Harness 18-909-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)

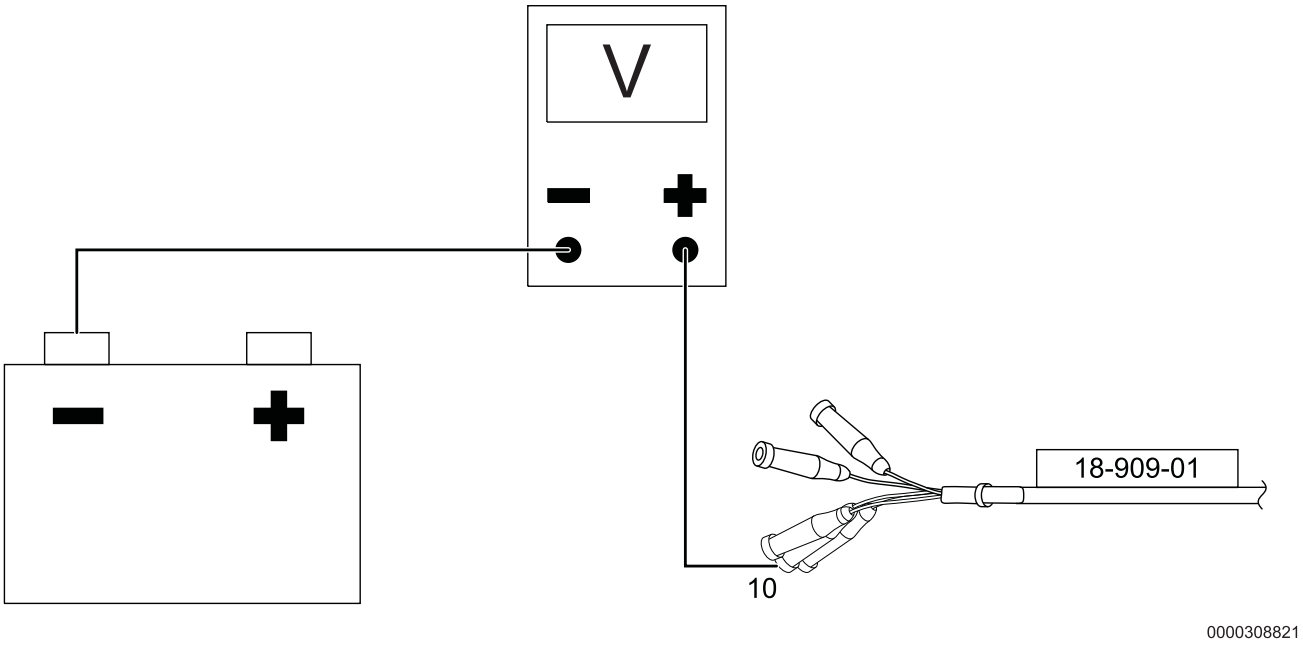


Figure 261 Test 1 DEF: SP Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-909-01 pin-10 and known good ground.	Less than 8.5 volts
Decision	
Is voltage less than 8.5 volts?	Yes: Go to Test 2.
	No: Repair short to PWR between DEF supply module pin-10 and Aftertreatment Control Module (ACM) pin J2-48. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3361 FMI 3.

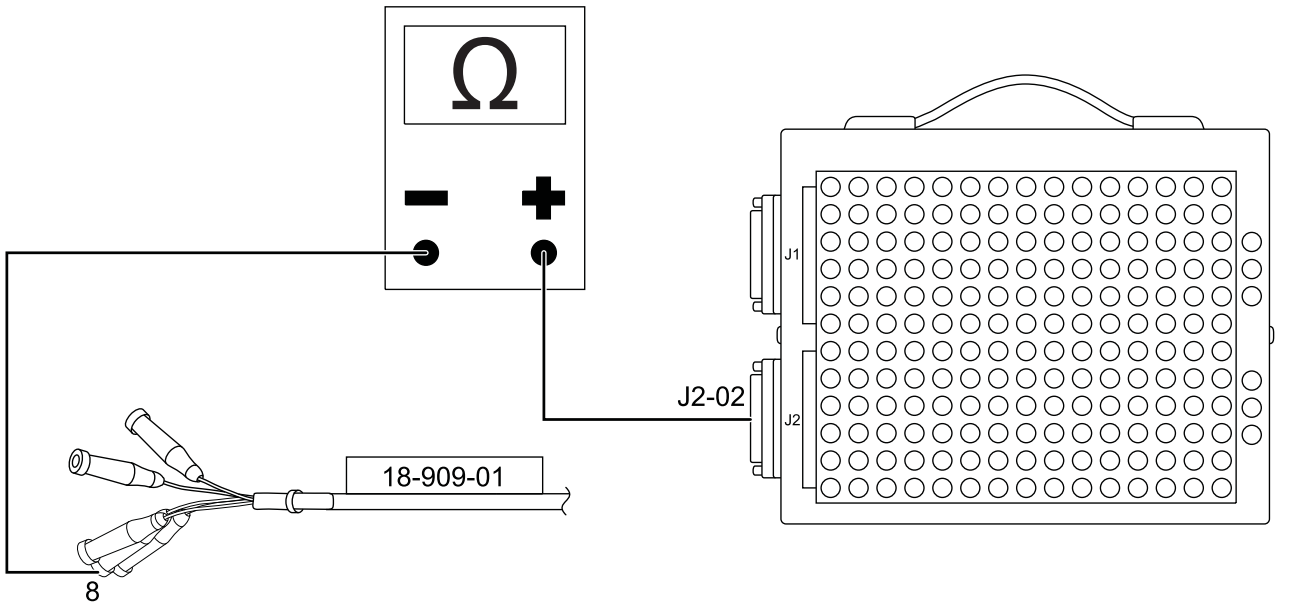


Figure 262 Test 2 DEF: SP Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-909-01 to DEF supply module vehicle harness connector and leave DEF supply module disconnected. C. Connect 180-pin breakout box and Breakout Harness 18-537-01 to ACM and leave module disconnected.

Test 2	Specification
Using DMM, measure resistance between Breakout Harness 18-909-01 breakout box pin J2-02.	Resistance is less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF supply module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3361 FMI 3.
	No: Repair Open or high resistance between DEF supply module pin-8 and Aftertreatment Control Module (ACM) pin J2-02. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3361 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3361 FMI 3 fault code diagnostics.

SPN 3361 FMI 4 - DEFSP Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Pump (DEFSP) temp / CTL circuit voltage signal is below normal or shorted to low source.	DEFSP motor driver line to ground > 500,000 ohms.	System has passed Diesel Exhaust Fluid (DEF) supply module temperature reading phase, and started controlling DEF pump motor DEF Supply Module power channel is ON DEF supply module power command is ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects resistance between the DEFSP motor driver line and ground is over 500,000 ohms. Diesel Exhaust Fluid (DEF) injection into exhaust system is disabled, and engine torque is reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test.

Possible Causes

- DEFSP temp / CTL circuit short to ground
- DEFSP circuit high resistance or open
- DEFSP temp / CTL circuit high resistance or open
- Failed DEF supply module

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3361 FMI 4. Does EST DTC list show SPN 3361 FMI 4 as active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

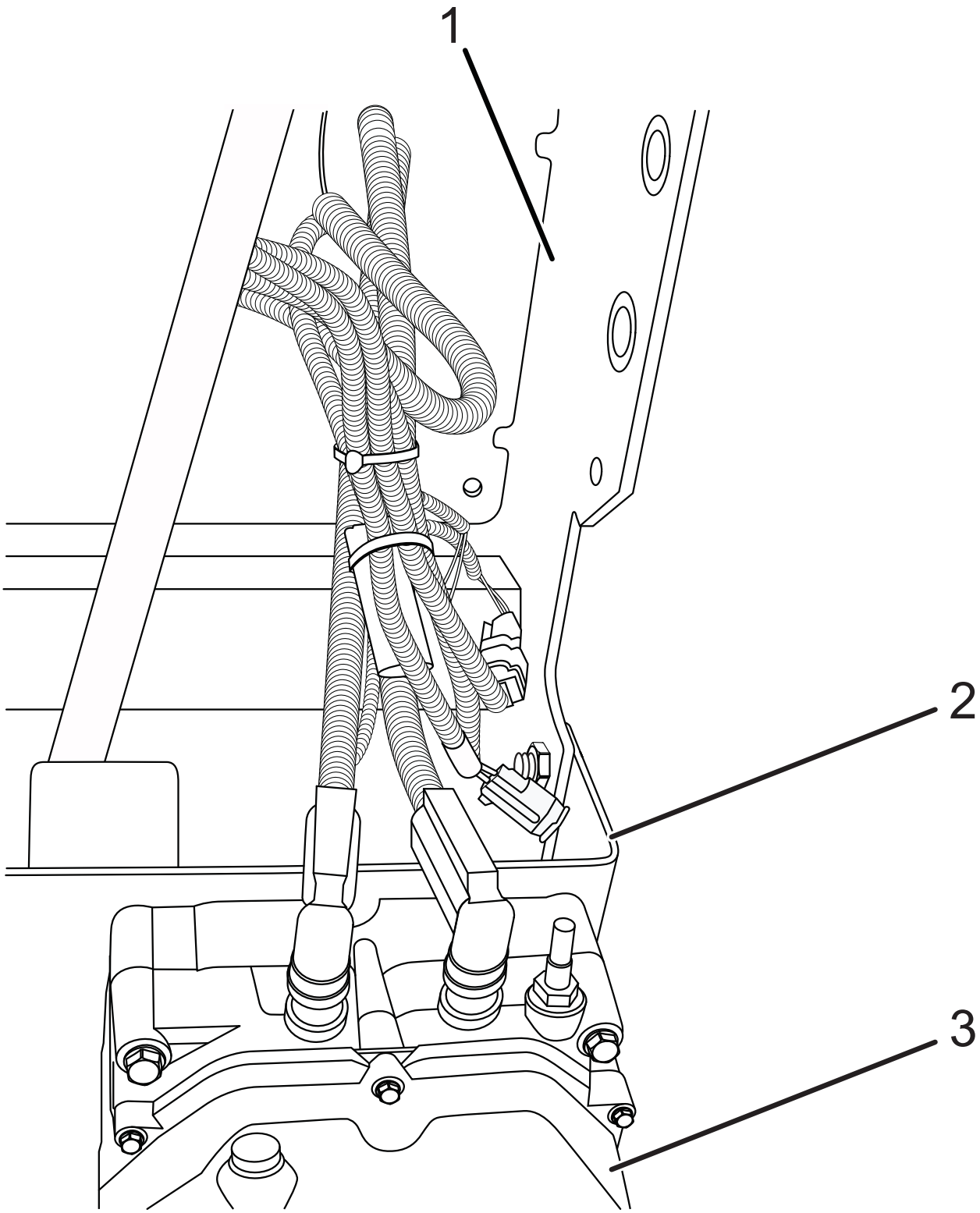


Figure 263 DEF Supply Module Location (Typical)

1. DEF tank assembly
2. DEF supply module bracket
3. DEF supply module

Step 2	Inspect connections at Diesel Exhaust Fluid (DEF) supply module connector.	Decision
A. Key OFF. B. Disconnect DEF supply module connector. C. Check DEF supply module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are DEF supply module connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3361 FMI 4.

Step 3	Check DEFSP Circuit Resistance.	Decision
Perform Test 1(page 719). Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and known good GND.		Yes: Go to Step 4.
Is resistance greater than 1000 ohms?		No: Repair short to ground between DEF supply module pin-10 and Aftertreatment Control Module (ACM) pin J2-48. After repairs are complete, perform the KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3361 FMI 4.

Step 4	Check DEFSP Circuit Resistance.	Decision
Perform Test 2(page 720). Use DMM to measure resistance between Breakout Harness 18-909-01 pin-9 and Breakout Box 00-00956-08 pin J2-46.		Yes: Go to Step 5.
Is resistance less than 5 ohms?		No: Repair open or high resistance between DEF supply module pin-9 and ACM pin J2-46. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3361 FMI 4.

Step 5	Check DEFSP Circuit Resistance.	Decision
Perform Test 3(page 721). Use DMM to measure resistance between Breakout Harness 18-909-01 pin-10 and Breakout Box 00-00956-08 pin J2-48.		Yes: Replace DEF supply module. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3361 FMI 4.
Is resistance less than 5 ohms?		No: Repair open or high resistance between DEF supply module pin-10 and ACM pin J2-48. After repairs are complete, perform SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3361 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3361 FMI 4 fault code diagnostics.

Pin-Point Tests (SPN 3361 FMI 4)

DEF: SP and Temperature Sensor Circuit

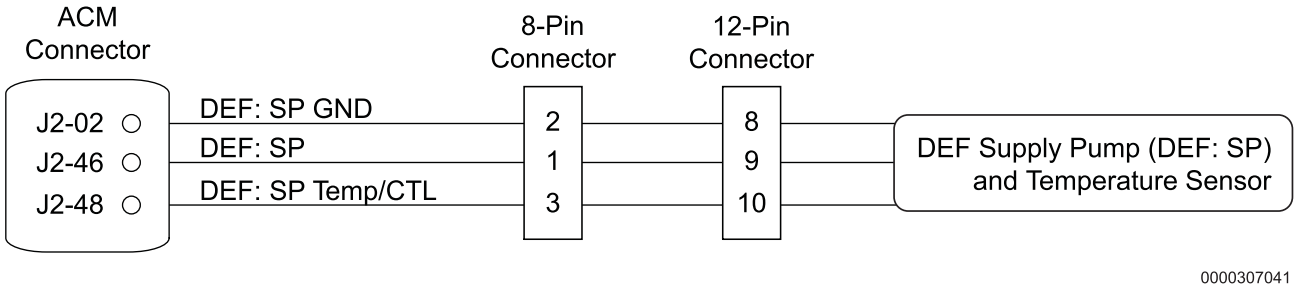


Figure 264 DEFSP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- Breakout Harness 18-909-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)

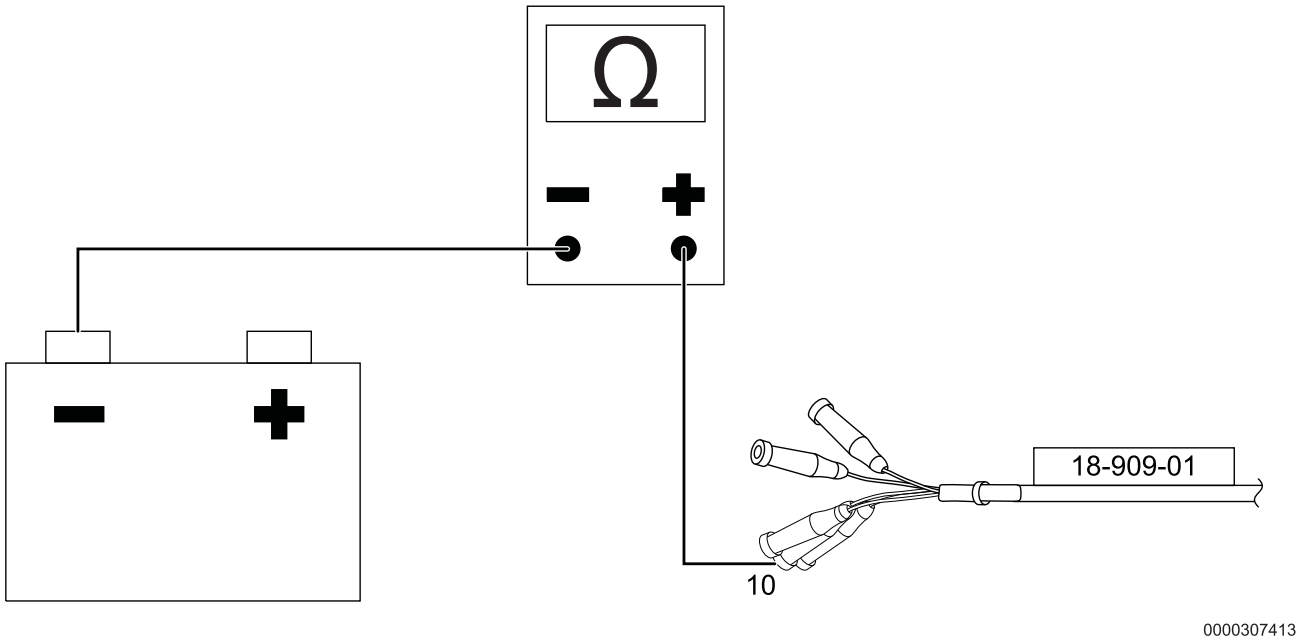


Figure 265 Test 1 DEFSP Circuit Resistance Check

Test 1
A. Key OFF. B. Connect Breakout Harness 18-909-01 to vehicle harness connector and leave DEF supply module disconnected.

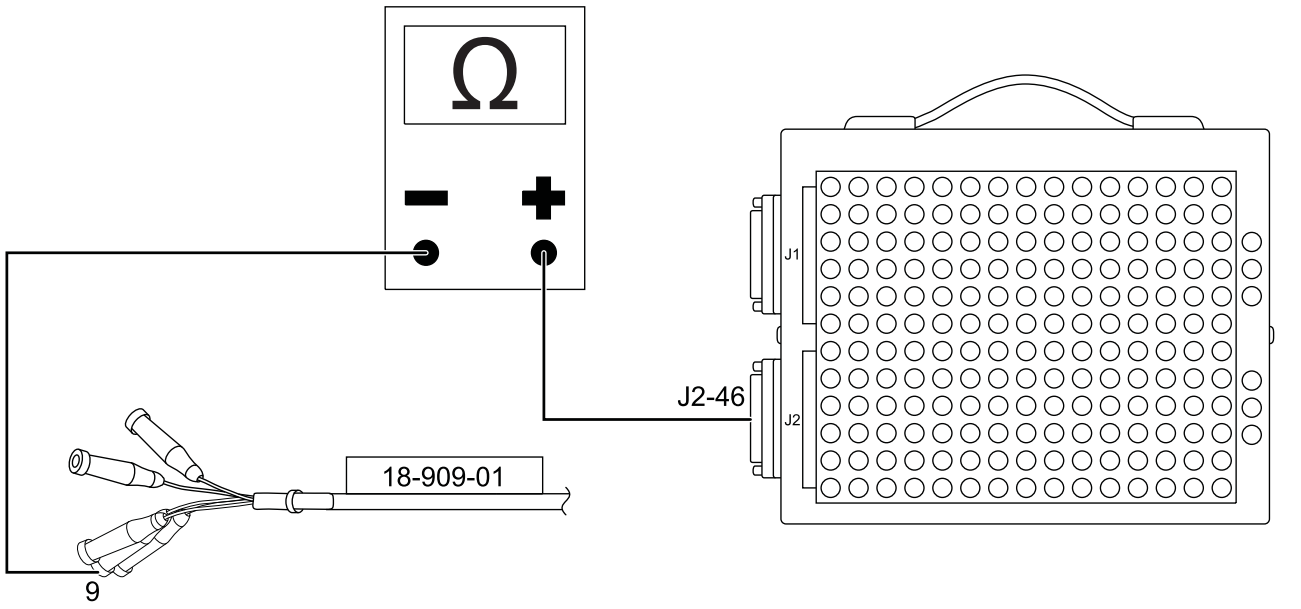


Figure 266 Test 2 DEFSP Circuit Resistance Check

Test 2
A. Key OFF.
B. Connect breakout harness 18-909-01 to vehicle harness and leave DEF supply module disconnected.
C. Connect 180-pin Breakout Box and Breakout Harness 18-537-01 to ACM vehicle harness connector and leave module disconnected.

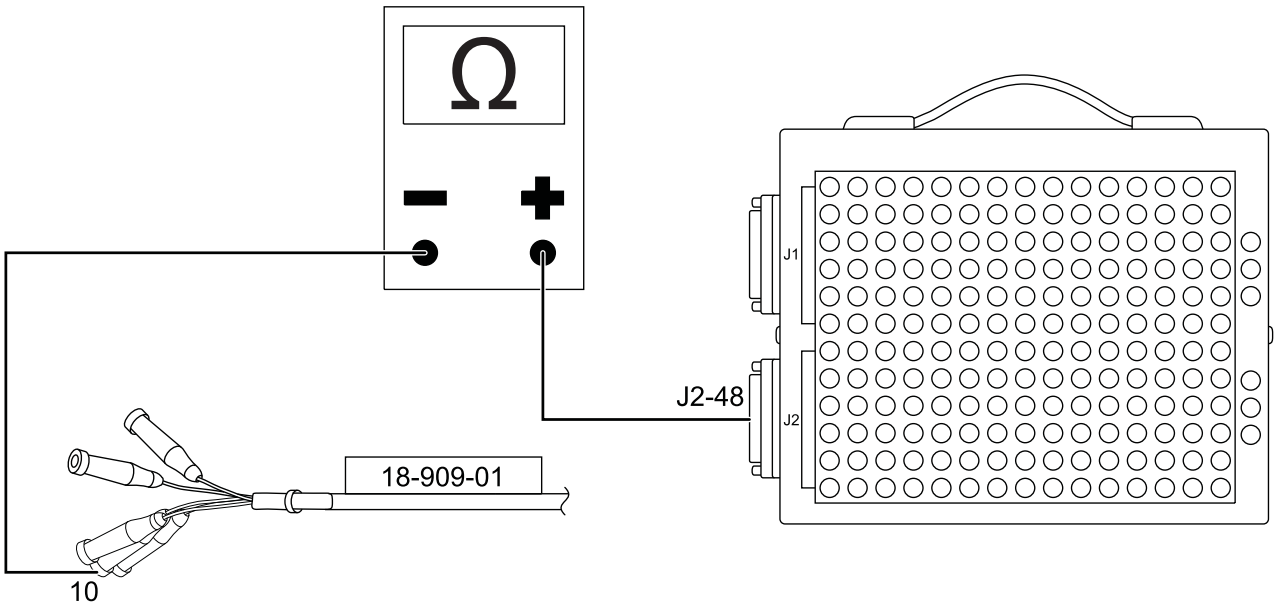


Figure 267 Test 3 DEFSP Circuit Resistance Check

Test 3
A. Key OFF. B. Connect Breakout Harness 18-909-01 to vehicle harness and leave DEF supply module disconnected. C. Connect 180-pin breakout box and Breakout Harness 18-537-01 to ACM vehicle harness connector and leave module disconnected.

SPN 3362 FMI 31 - DEF Dosing Unable to Prime

Condition / Description	Setting Criteria	Enable Conditions / Values
Checks whether the Diesel Exhaust Fluid (DEF) dosing system fails to prime after a calibrated number of attempts.	DEF supply pressure does not exceed 29 psi (200 kPa) within 200 seconds from the time DEF Supply Module has begun filling with DEF, or 200 seconds has elapsed since the DEF Supply Module has begun filling with DEF DEF supply pressure does not remain between 116 psi (800 kPa) and 145 psi (1,000 kPa) for 3 seconds or longer for more than 5 times	DEF Supply Module has begun filling with DEF Inactive: SPN 3361 FMI 3 and 4 (DEF: SP), and SPN 4334 FMI 2, 3, and 4 (DEF: AP)

Fault Overview

Fault code sets when Diesel Exhaust Fluid Supply Pump (DEF: SP) is unable to successfully build pressure or prime after multiple attempts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1761 FMI 18 (DEF: TLT)	• SPN 3363 FMI 7, 16, and 18 (DEF: THC)	• SPN 4334 FMI 2, 16, and 18 (DEF: AP)	

Fault Facts

Fault may set if DEF supply module was not allowed to shut down and purge fully following a re-calibration of Engine Control Module (ECM). A full key cycle that allows dosing unit to purge, followed by a priming cycle, should correct this issue.

Drive Cycle to Determine Fault Status

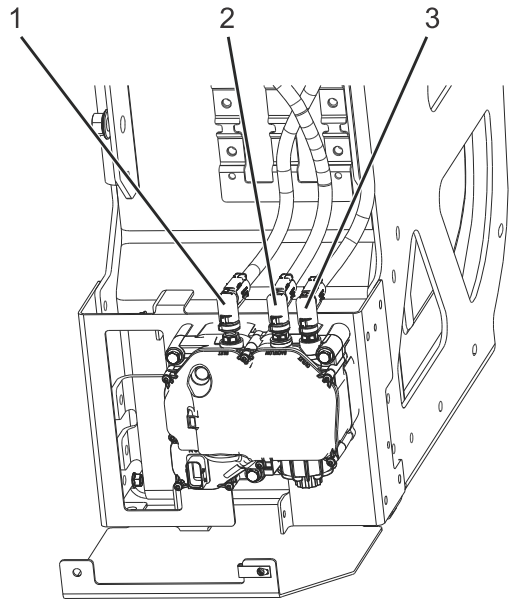
Continuous

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 722). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3362 FMI 31.

Step 2	Visually inspect Diesel Exhaust Fluid (DEF) tank.	Decision
Check DEF tank for debris or foreign particles. Also check DEF tank vent for restrictions or fluid crystallization. Are DEF tank and DEF tank vent clean and free of debris, restrictions, and fluid crystallization?		Yes: Go to Step 3. No: Drain DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.

Step 3	Check for DEF line heater related faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 3363 FMI 7, 16, and 18 (DEF: THC). Is EST DTC list free of SPN 3363 FMI 7, 16, and 18 (DEF: THC)?		Yes: Go to Step 4. No: Repair SPN 3363 FMI 7, 16, and 18. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.

Step 4	Check for DEF line pressure related faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 4334 FMI 2, 16, and 18 (DEF: AP). Is EST DTC list free of SPN 4334 FMI 2, 16, and 18?		Yes: Go to Step 5. No: Repair SPN 4334 FMI 2, 16, and 18. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.



0000054407

Figure 268 DEF Supply Module Line Routing

1. DEF supply module supply line
2. DEF supply module return line
3. DEF supply module pressure line

Step 5	Check for DEF supply and return line.	Decision
A. Key OFF. B. Check DEF supply and return line are not reversed between supply module and DEF tank. C. Verify supply and return lines are not swapped at DEF supply module or DEF tank. Are DEF supply and return lines correctly routed?		Yes: Go to Step 6. No: Connect DEF supply and return lines to correct locations. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.

Step 6	Check DEF tank	Decision
Check DEF tank, DEF supply module, and DEF doser valve lines and connections for cracks and pitting, and loose, leaking, or damaged connections. Are DEF tank, DEF supply module, and DEF doser valve lines and connections in good condition?		Yes: Go to Step 7. No: Repair or replace failed line or connection. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.

Step 7	Check DEF supply module supply line for restrictions.	Decision
Disconnect both ends of supply line and blow compressed air through supply line. Does compressed air flow freely through supply line?		Yes: Clean DEF supply module using 18-200-01 and perform drive cycle 30. See DEF Supply Module Flush (page 80).If SPN 3362 FMI 31 is still active, replace DEF supply module. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31. No: Clean or replace DEF supply module supply line. After repairs are complete, perform KOEO SCR Faults Reset Request Procedure (page 2170) and retest for SPN 3362 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3362 FMI 31 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

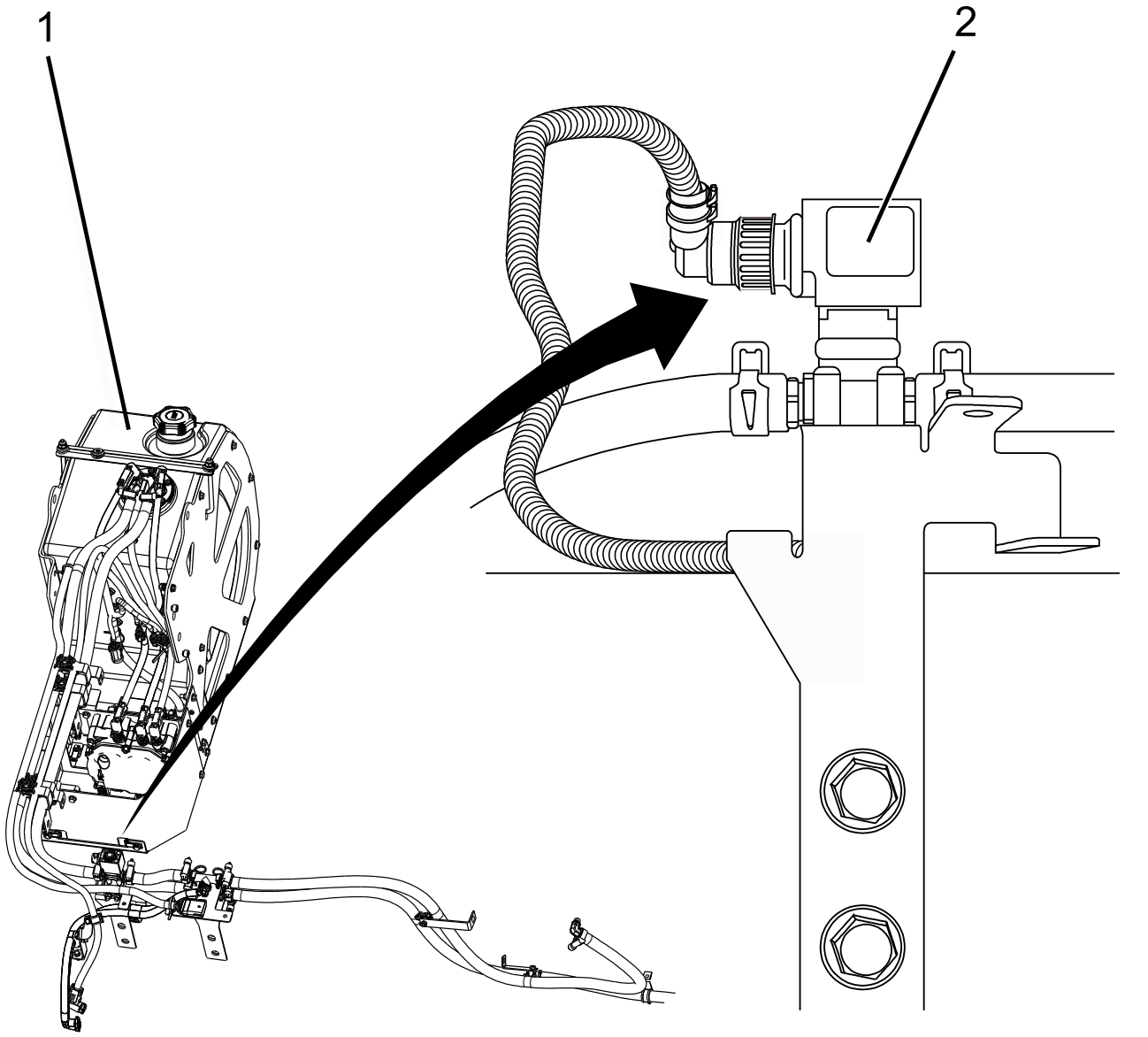
DEF: THC (Diesel Exhaust Fluid Tank Heater Control) Valve

Overview of DEF: THC

SPN	FMI	Description
3363	3	DEF Tank Heater Control Valve short to PWR (page 729)
3363	4	DEF Tank Heater Control Valve short to GND (page 735)
3363	7	DEF Tank Heater Control Valve Mechanical system not responding (page 740)
3363	16	DEF Tank Heater Control Valve stuck open fault (page 742)
3363	18	DEF Tank Heater Control Valve unable to thaw frozen DEF (page 744)

Overview

Diesel Exhaust Fluid Tank Heater Control (DEF: THC) controls flow of coolant to DEF tank to thaw or prevent freezing of DEF. When DEF temperature is low, Aftertreatment Control Module (ACM) commands DEF: THC open to allow coolant flow to DEF tank. ACM opens DEF: THC by sending power through DEF: THC CTL circuit. DEF: THC GND circuit is constantly grounded through ACM.



0000057654

Figure 269 DEF: THC Sensor Location

1. Diesel Exhaust Fluid (DEF) tank
2. Diesel Exhaust Fluid Tank Heater Control (DEF: THC)

SPN 3363 FMI 3 - DEF Tank Heater Control Valve short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Heater Control (DEF: THC) CTL is shorted to high source or open.	DEF: THC CTL resistance > 500,000 ohms.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects voltage signal from Diesel Exhaust Fluid Tank Heater Control (DEF: THC) is high or Open circuit for 3 seconds. DEF tank heating is disabled. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: THC CTL circuit short to PWR
- DEF: THC CTL circuit Open or high resistance
- DEF: THC GND circuit Open or high resistance
- Failed DEF: THC

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3363 FMI 3. Is EST DTC list showing SPN 3363 FMI 3 as active or pending?		Yes: Go to Step 2. No: Go to Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, retest for SPN 3363 FMI 3.

Step 2	Inspect connections at DEF: THC connector.	Decision
A. Key OFF. B. Disconnect DEF: THC connector. C. Check DEF: THC and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: THC connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3363 FMI 3.

Pin-Point Tests (SPN 3363 FMI 3)

DEF: THC

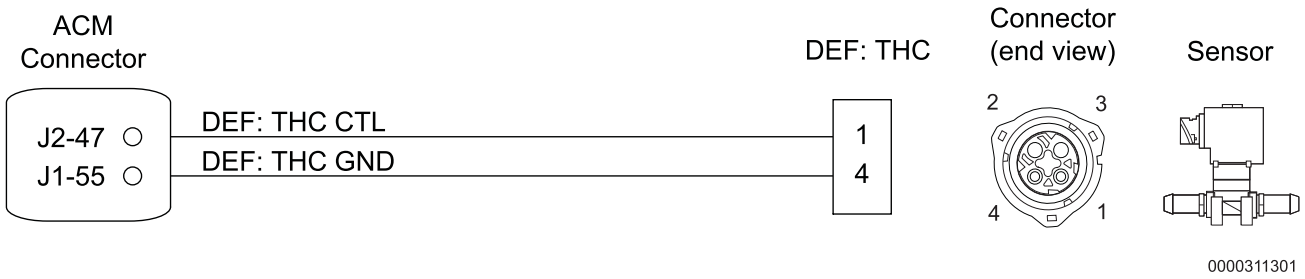


Figure 270 Diesel Exhaust Fluid Tank Heater Control (DEF:THC) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-Pin Breakout Box 00-00956-08
- Breakout Harness 18-537-01
- Breakout Harness ZTSE4827
- Digital Multimeter (DMM)

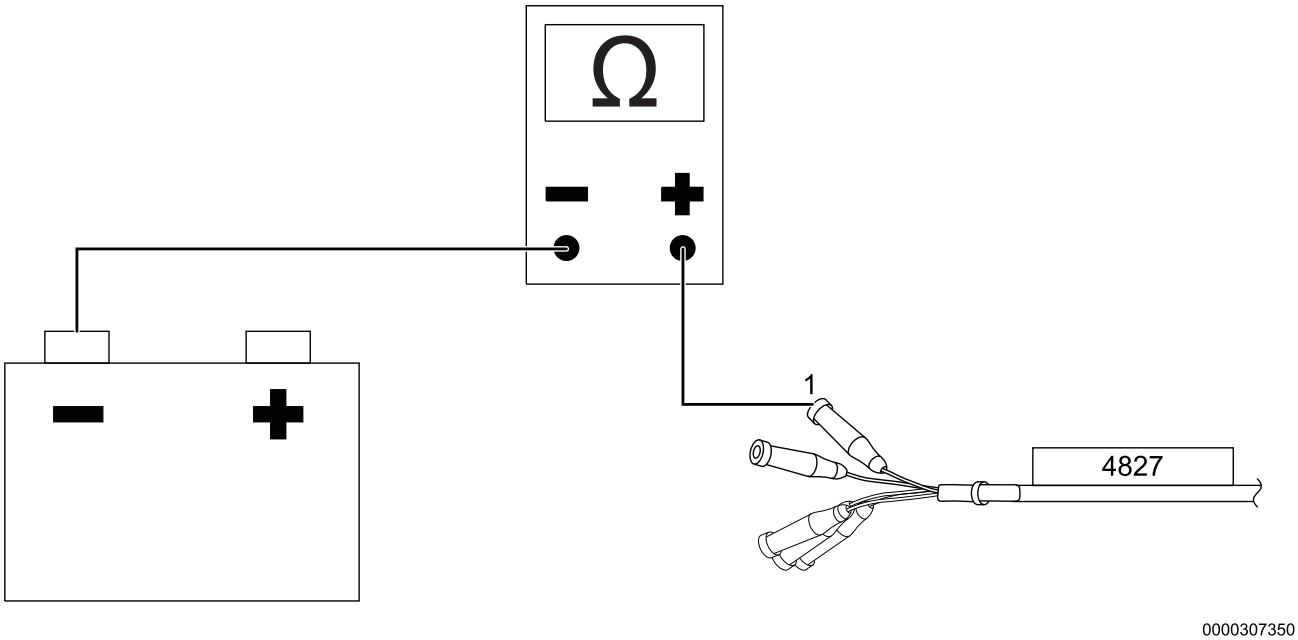
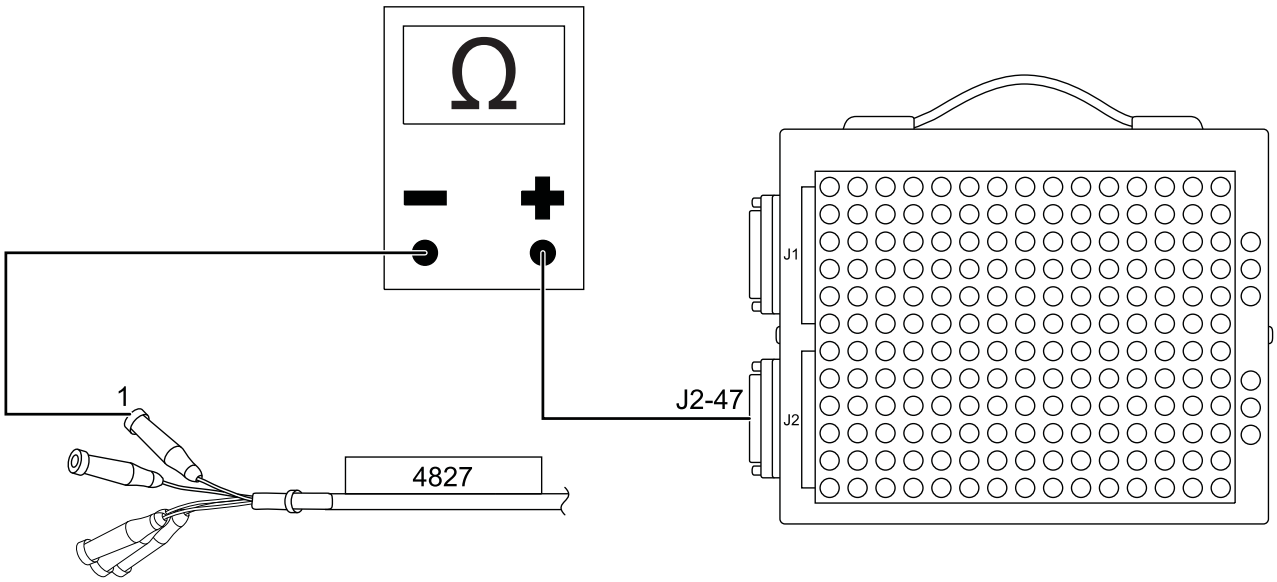


Figure 271 Test 1 Diesel Exhaust Fluid Tank Heater Control (DEF: THC) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Tank Heater Control (DEF: THC) valve. C. Connect Breakout Harness ZTSE4827 to vehicle harness and leave DEF: THC disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4827 pin-1 and known good GND.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 2.
	No: Repair short to PWR between DEF: THC pin-1 and Aftertreatment Control Module (ACM) connector pin J2-47. After repairs are complete, retest for SPN 3363 FMI 3.

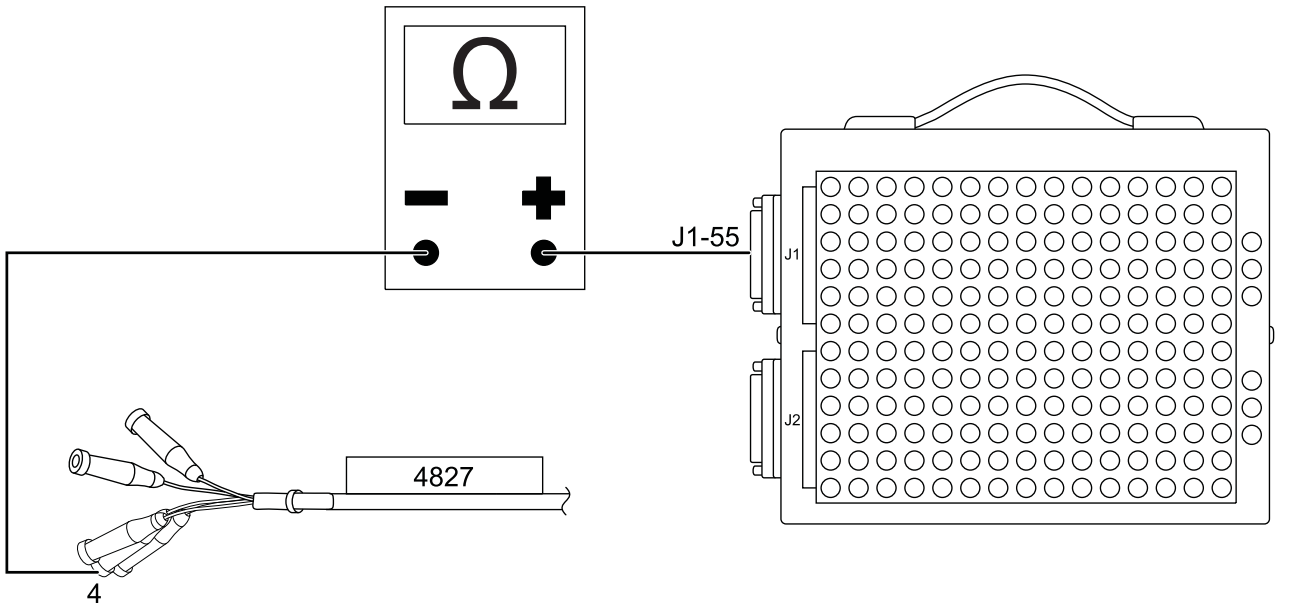


0000307525

Figure 272 Test 2 Diesel Exhaust Fluid Tank Heater Control (DEF: THC) Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Tank Heater Control (DEF: THC). C. Connect Breakout Harness ZTSE4827 to vehicle harness and leave DEF: THC disconnected. D. Connect 180-pin breakout box 00-00956-08 and Breakout Harness 18-537-01 to vehicle harness and leave Aftertreatment Control Module (ACM) disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4827 pin-1 and 180-pin breakout box 00-00956-08 pin J2-47.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3.
	No: Repair Open or high resistance between DEF: THC pin-1 and ACM connector pin J2-47. After repairs are complete, retest for SPN 3363 FMI 3.



0000307546

Figure 273 Test 3 Diesel Exhaust Fluid Tank Heater Control (DEF:THC) Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Tank Heater Control (DEF:THC). C. Connect Breakout Harness ZTSE4827 to vehicle harness and leave DEF:THC disconnected. D. Connect 180-pin breakout box 00-00956-08 and Breakout Harness 18-537-01 to ACM vehicle harness and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4827 pin-4 and 180-pin breakout box 00-00956-08 pin J1-55.	Less than 5 ohms.
Decision	
Is resistance less than 5 ohms?	Yes: Replace DEF: THC. After repairs are complete, retest for SPN 3363 FMI 3.
	No: Repair Open or high resistance between DEF: THC pin-4 and ACM connector pin J1-55. After repairs are complete, retest for SPN 3363 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3363 FMI 3 fault code diagnostics.

SPN 3363 FMI 4 - DEF Tank Heater Control Valve short to GND

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Heater Control (DEF: THC) CTL is shorted to ground.	The resistance between DEF: THC CTL and ground < 5 ohms.	Key ON DEF: THC is turned ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects voltage signal from Diesel Exhaust Fluid Tank Heater Control (DEF: THC) is low for 3 seconds. DEF tank heating is disabled. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: THC CTL circuit shorted to GND
- DEF: THC GND circuit shorted to DEF: THC CTL circuit
- Failed DEF: THC

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3363 FMI 4. Is EST DTC list showing SPN 3363 FMI 4 as Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, retest for SPN 3363 FMI 4.

Step 2	Inspect connections at Diesel Exhaust Fluid Tank Heater Control (DEF: THC) control connector.	Decision
A. Key OFF. B. Disconnect DEF: THC connector. C. Check DEF: THC and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: THC connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3363 FMI 4.

Pin-Point Tests (SPN 3363 FMI 4)

DEF: THC

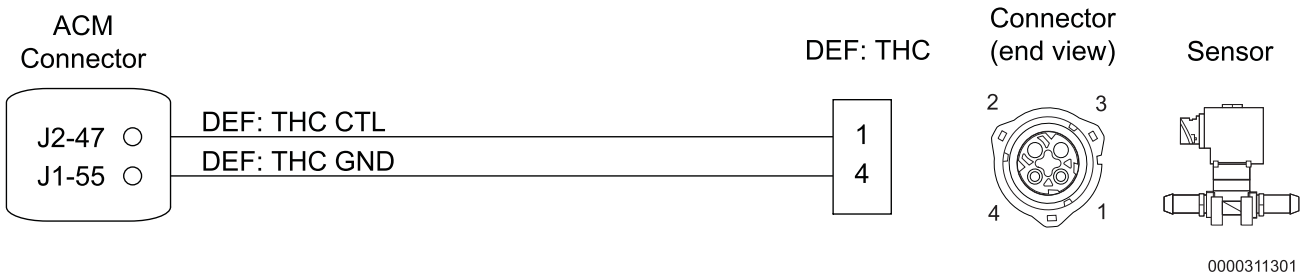


Figure 274 Diesel Exhaust Fluid Tank Heater Control (DEF: THC) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4827
- Digital Multimeter (DMM)

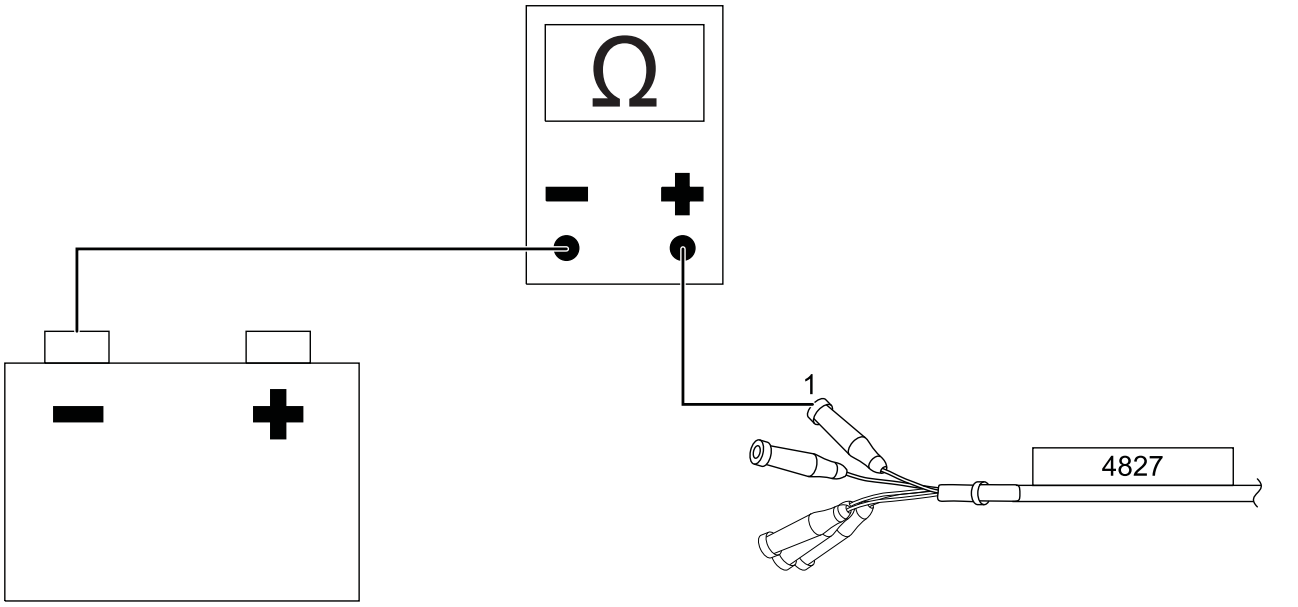
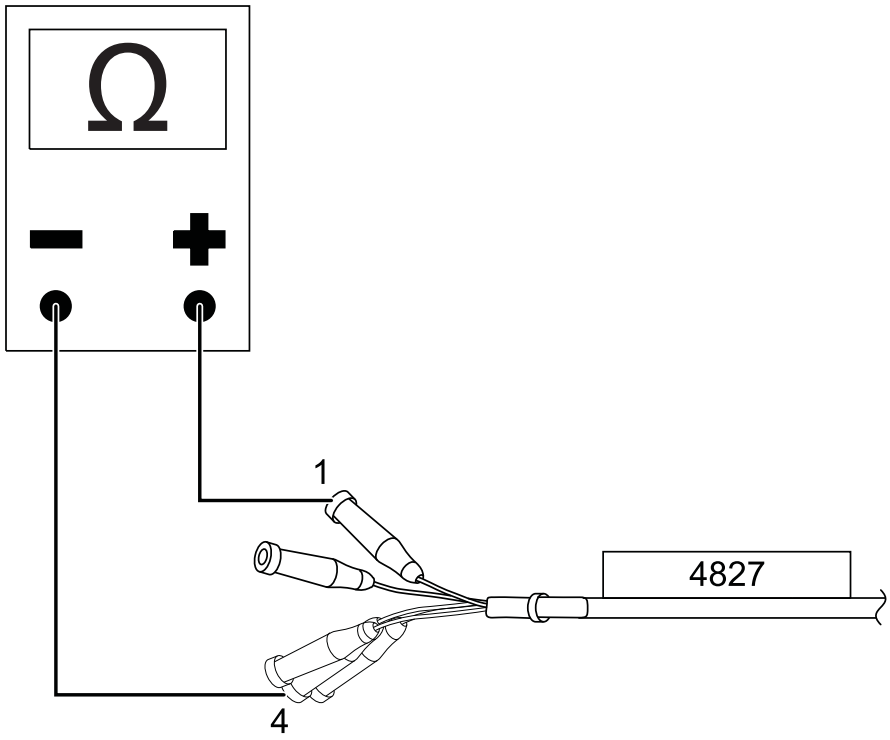


Figure 275 Test 1 DEF: THC Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Tank Heater Control (DEF: THC). C. Connect Breakout Harness ZTSE4827 to vehicle harness connector and leave disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4827 pin-1 and known good GND.	Greater than 1000 ohms.
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to GND between DEF: THC connector pin-1 and Aftertreatment Control Module (ACM) connector pin J2-47. After repairs are complete, retest for SPN 3363 FMI 4.



0000307360

Figure 276 Test 2 DEF: THC Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Diesel Exhaust Fluid Tank Heater Control (DEF: THC). C. Connect Breakout Harness ZTSE4827 to vehicle harness connector and leave DEF: THC disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4827 pin-1 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Replace DEF: THC. After repairs are complete, retest for SPN 3363 FMI 4.
	No: Repair short between DEF: THC connector pin-1 and DEF: THC connector pin-4. After repairs are complete, retest for SPN 3363 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3363 FMI 4 fault code diagnostics.

SPN 3363 FMI 7 - DEF Tank Heater Control Valve Mechanical system not responding

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) tank temperature does not rise when DEF tank heating is active.	DEF tank temperature change < 4°F (2°C)	Key-On Engine-Running (KOER) DEF tank temperature between 50°F (10°C) and -31°F (-35°C) Coolant temperature > 158°F (70°C) Ambient air temperature > -22°F (-30°C) DEF tank heater commanded ON The following fault codes are inactive: SPN 3031 FMI 2, 3, and 4, SPN 3363 FMI 3, and 4.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) commands Diesel Exhaust Fluid Tank Heater Control (DEF: THC) ON and signal from Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensors do not show an increase in DEF temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3031 FMI 2, 3, and 4 (DEF: TT) • SPN 4344 FMI 3 and 5 (DEF: L3HC)	• SPN 3363 FMI 3 and 4 (DEF: THC) • SPN 5745 FMI 3 and 4 (DEF: SMH)	• SPN 4340 FMI 3 and 5 (DEF: L1HC)	• SPN 4342 FMI 3 and 5 (DEF: L2HC)

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Exhaust Fluid Tank Heater Control (DEF: THC) valve
- Coolant line from DEF: THC to DEF tank leaking, damaged, kinked, or restricted
- Coolant supply line to DEF: THC leaking, damaged, kinked, or restricted
- Low engine coolant level

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 740). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3363 FMI 7.

Step 2	Check engine coolant level.	Decision
Perform Coolant Level Inspection (page 2355). Is coolant level within specification and free of contamination?		Yes: Go to Step 2. No: Add engine coolant as necessary. After repairs are complete, retest for SPN 3363 FMI 7.

Step 3	Check coolant line from Diesel Exhaust Fluid Tank Heater Control (DEF: THC) to DEF tank.	Decision
Check coolant line from DEF: THC to DEF tank for leaks or damage; kinks or restrictions; loose connections; and leaking seals or gaskets. Is coolant line from DEF: THC to DEF tank unrestricted and in good condition?		Yes: Go to Step 4. No: Repair or replace leaking or damaged coolant line from DEF: THC to DEF tank, fittings, or seals. Check engine coolant level and add as necessary. After repairs are complete, retest for SPN 3363 FMI 7.

Step 4	Check coolant line to DEF: THC.	Decision
Check coolant supply line to DEF: THC for leaks or damage; kinks or restrictions; loose connections; and leaking seals or gaskets. Is coolant line from DEF: THC to DEF tank unrestricted and in good condition?		Yes: Replace DEF: THC. After repairs are complete, retest for SPN 3363 FMI 7. No: Repair or replace leaking or damaged coolant supply line from DEF: THC to engine, fittings, or seals. Check engine coolant level and add as necessary. After repairs are complete, retest for SPN 3363 FMI 7.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3363 FMI 7 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3363 FMI 16 - DEF Tank Heater Control Valve stuck open fault

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Heater Control (DEF: THC) is ON when commanded OFF.	DEF temperature above normal operating range	Key ON DEF tank temperature > 170°F (77°C) Inactive: SPN 3031 FMI 2, 3, and 4 (DEF: TT)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines Diesel Exhaust Fluid Tank Heater Control (DEF: THC) is ON when commanded OFF due to DEF Tank Temperature (DEF: TT) above 170°F (77°C). Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3031 FMI 2, 3, and 4 (DEF: TT)	• SPN 3363 FMI 3, and 4 (DEF: THC)		

Fault Facts

If there is a problem with DEF: THV, such as valve stuck open, coolant leaking past valve seat, or valve is incorrectly installed, it can take long periods of operation at high load before tank temperature gradually increases to fault code threshold of 170°F (77°C). When temperature drops below 167°F (75°C) due to a stopped engine, overnight parking, or reduced coolant temperature, fault code will go inactive while root cause of the issue is still present.

Drive Cycle to Determine Fault Status

estimating Continuous

Possible Causes

- Failed Diesel Exhaust Fluid Tank Heater Control (DEF: THC) valve
- DEF: THC installed incorrectly (missing, bypassed, or reversed)
- Failed Diesel Exhaust Fluid Tank Level (DEF: TL) and DEF Tank Temperature (DEF: TT) sensor module
- Auxiliary DEF tank heater installed

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 742). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3363 FMI 16.

Step 2	Check for auxiliary Diesel Exhaust Fluid (DEF) tank heater.	Decision
Inspect vehicle for an auxiliary DEF tank heater. Is vehicle free of an auxiliary DEF tank heater?		Yes: Go to Step 3. No: Remove auxiliary DEF tank heater. After repairs are complete, retest for SPN 3363 FMI 16.

Step 3	Check for failed DEF Tank Temperature (DEF: TT) sensor.	Decision
Using EST with ServiceMaxx™ software, load the signals session and monitor the DEF: TT signal. Measure DEF: TT using Infrared Thermometer ZTSE4799 from the bottom of the DEF tank. Is EST reading within 18°F (10°C) of Infrared Thermometer reading?		Yes: Go to Step 4. No: Replace DEF: TL and DEF: TT sensor module. After repairs are complete, retest for SPN 3363 FMI 16.

Step 4	Verify DEF Tank Heater Control (DEF: THC) is installed correctly.	Decision
Verify DEF: THC is installed correctly (not missing, bypassed, or reversed). Is DEF: THC installed correctly?		Yes: Replace DEF: THC. After repairs are complete, retest for SPN 3363 FMI 16. No: Install DEF: THC correctly (see *Exhaust System Service Manual*). After repairs are complete, retest for SPN 3363 FMI 16.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3363 FMI 16 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3363 FMI 18 - DEF Tank Heater Control Valve unable to thaw frozen DEF

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) tank temperature has failed to reach target threshold within predetermined time after heating is commanded.	DEF tank temperature remains less than 19°F (-7°C) after DEF tank heating is commanded active	Key-On Engine-Running (KOER) Inactive: SPN 3031 FMI 2, 3, and 4, SPN 3363 FMI 3, and 4 DEF tank temperature between 50°F (10°C) and -31°F (-35°C) Coolant temperature > 158°F (70°C) Ambient air temperature > -22°F (-30°C) DEF tank heater commanded ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines Diesel Exhaust Fluid Tank Heater Control (DEF: THC) has been on long enough to thaw Diesel Exhaust Fluid (DEF), but DEF dosing system is unable to prime.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3031 FMI 2, 3, and 4 (DEF: TLT)	• SPN 3363 FMI 3, and 4 (DEF: THC)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEF: THC valve (stuck closed)
- Coolant line from DEF: THC to DEF tank leaking, damaged, kinked, or restricted
- Coolant supply line to DEF: THC leaking, damaged, kinked, or restricted
- Low engine coolant level

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 744). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3363 FMI 18.

Step 2	Inspect the coolant level.	Decision
Check engine coolant level. Is engine coolant at the correct level?		Yes: Go to Step 3. No: Add engine coolant as necessary. After repairs are complete, retest for SPN 3363 FMI 18.

Step 3	Inspect coolant line.	Decision
Check coolant line from DEF: THC to DEF tank for leaks or damage; kinks or restrictions; loose connections; and leaking seals or gaskets. Is coolant line from DEF: THC to DEF tank unrestricted and in good condition?		Yes: Go to Step 4. No: Repair or replace leaking or damaged coolant line from DEF: THC to DEF tank, fittings, or seals. Check engine coolant level and add as necessary. After repairs are complete, retest for SPN 3363 FMI 18.

Step 4	Inspect coolant supply line.	Decision
Check coolant supply line to DEF: THC for leaks or damage; kinks or restrictions; loose connections; and leaking seals or gaskets. Is coolant line from DEF: THC to DEF tank unrestricted and in good condition?		Yes: Replace DEF: THC. After repairs are complete, retest for SPN 3363 FMI 18. No: Repair or replace leaking or damaged coolant line from DEF: THC to DEF tank, fittings, or seals. Check engine coolant level and add as necessary. After repairs are complete, retest for SPN 3363 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3363 FMI 18 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

DEF: TL & DEF: TT (Diesel Exhaust Fluid Tank Level and Temperature) Sensor Module

Overview of DEF: TL & DEF: TT Sensor Group

SPN	FMI	Description
1569	31	SCR Tamperproof Warning & Protection System Inducement Severe (page 747)
1761	1	DEFTL Inducement (Level 3 - 4) (page 749)
1761	3	DEFTL signal Out of Range HIGH (page 751)
1761	4	DEFTL signal Out of Range LOW (page 753)
1761	10	DEF Level abnormal rate of change (page 755)
1761	11	DEFTL signal erratic, intermittent, or incorrect (page 757)
1761	17	DEFTL Inducement Level 1 (page 759)
1761	18	DEFTL Inducement Level 2 (page 761)
1761	19	DEFTL not detected on J1939 (page 763)
3031	2	DEFTT signal erratic, intermittent or incorrect (page 765)
3031	3	DEFTT signal Out of Range HIGH (page 770)
3031	4	DEFTT signal Out of Range LOW (page 772)
3521	11	Improper Reductant in DEF Tank (Contaminated Reductant) (page 774)
4094	31	DEF below acceptable quality (page 776)
5246	15	SCR Tamper Proof Inducement Level 1 status (No signal return from aftertreatment) (page 780)

Overview

Diesel Exhaust Fluid Tank Level (DEF: TL) sensor is a combination sensor used to monitor DEF tank level and DEF tank temperature. DEF: TL and DEF: TT sensor is installed inside DEF tank and is a smart sensor that communicates to Aftertreatment Control Module (ACM) through J1939 Private CAN.

SPN 1569 FMI 31 - SCR Tamperproof Warning & Protection System Inducement Severe

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Control Module (ACM) detects an Open circuit in aftertreatment system.	No signal return from an aftertreatment component	Key ON

Fault Overview

Fault code sets when any aftertreatment sensor or actuator is Open or disconnected for at least 1 hour. After 1 hour (level 2), engine will be de-rated by 25%. After 5 hours (level 3 and 4), engine will be de-rated by 40%, and Engine Control Module (ECM) will illuminate Red Stop Lamp (RSL) and turn on warning buzzer.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Any aftertreatment open circuit faults			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- PP reset of "SCR Faults Reset Request" is needed to remove inducement effects.

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 747). Are Associated Faults active?		Yes: Repair Associated Faults. After repairs are complete, retest for SPN 1569 FMI 31.
		No: Test drive vehicle and retest for SPN 1569 FMI 31. If fault does not return, notify supervisor for further action.

End Diagnostic Steps
After performing diagnostic step, if SPN 1569 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1761 FMI 1 - DEFTL Inducement (Level 3 - 4)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DEF Level System Warning and Protection Inducement Level 4 DEF Level System Warning and Protection Inducement Level 5	DEF Level ≤ 10%	Engine Running SPN FMI's 1761/3, 1761/4 and 1761/19 not active

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

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CONTENT
UNDER
DEVELOPMENT

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SPN 1761 FMI 3 - DEFTL signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Exhaust Fluid Tank Level (DEF: TL) sensor circuit voltage above normal or shorted to high source.	Aftertreatment Control Module (ACM) detects DEF: TL signal voltage is > 4.5 volts for more than 1 second.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Level (DEF: TL) signal voltage is greater than 4.5 volts for 1 second. Engine torque will be reduced if fault is active for a limited period of time. Engine torque will be severely reduced after extended engine operation with fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEF: TL and DEF: TT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 1761 FMI 3. Is EST DTC list SPN 1761 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Diesel Exhaust Fluid Tank Level (DEF: TL) sensor.	Decision
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector. C. Check DEF: TL and DEF: TT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL and DEF: TT sensor connector, harness, and terminal clean and undamaged?		Yes: Replace DEF: TL and DEF: TT sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 1761 FMI 3. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 1761 FMI 3.

End Diagnostic Steps
After performing diagnostic steps, if SPN 1761 FMI 3 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1761 FMI 4 - DEFTL signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Level (DEF: TL) sensor circuit voltage below normal or shorted to low source.	Aftertreatment Control Module (ACM) detects DEF: TL signal voltage is less than 0.25 volts for more than 1 second.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Level (DEF: TL) sensor signal voltage is less than 0.25 volts for more than 1 second. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEF: TL / DEF: TT sensor

Step 1	Inspect connections at Diesel Exhaust Fluid Tank Level (DEF: TL) / Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor.	Decision
A. Key OFF. B. Disconnect DEF: TL / DEF: TT sensor connector. C. Check DEF: TL / DEF: TT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL / DEF: TT sensor connector, harness, and terminal clean and undamaged?		Yes: Replace DEF: TL / DEF: TT sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 1761 FMI 4. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 1761 FMI 4.

End Diagnostic Steps
After performing diagnostic steps, if SPN 1761 FMI 4 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1761 FMI 10 - DEF Level abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Exhaust Fluid (DEF) tank level sensor circuit abnormal rate of change. A valid DEF tank level reading has not been received.	DEF tank level reading was invalid for an extended period of time.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Level (DEF: TL) signal is invalid for an extended period of time. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 3031 FMI 2 (DEF: TL)		

Fault Facts

Very low or empty DEF level, or frozen DEF, can set this fault.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low Diesel Exhaust Fluid (DEF) level
- Frozen DEF
- Failed sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 755). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1761 FMI 10.

Step 2	Check Diesel Exhaust Fluid (DEF) tank level.	Decision
Perform Diesel Exhaust Fluid (DEF) Level & Gauge Inspection(page 2383). Is DEF level in the DEF tank close to the level indicated on the DEF level gauge, and above 1/4 tank?		Yes: Go to Step 3. No: Replace DEF tank level sensor. After repairs are complete, retest for SPN 1761 FMI 10.

Step 3	Check vehicle history.	Decision
Has vehicle been subjected to temperatures at or below 12°F (-11°C) with Key-ON Engine-OFF?		Yes: Retest for SPN 1761 FMI 10. No: Replace DEF tank level sensor. After repairs are complete, retest for SPN 1761 FMI 10.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 1761 FMI 10 fault code diagnostics.

SPN 1761 FMI 11 - DEFTL signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Exhaust Fluid (DEF) tank level sensor circuit abnormal rate of change. A valid DEF tank level reading has not been received.	DEF tank level reading was invalid for an extended period of time.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Level (DEF: TL) signal is invalid for an extended period of time. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Exhaust Fluid (DEF) level sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 1761 FMI 11. Is EST DTC list SPN 1761 FMI 11 active or pending?		Yes: Replace DEF tank level sensor. After repairs are complete, retest for SPN 1761 FMI 11.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 1761 FMI 11 fault code diagnostics.

SPN 1761 FMI 17 - DEFTL Inducement Level 1

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) tank level is below critical threshold. Level 1 inducement.	DEF tank level < 10%	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid (DEF) tank level is less than 10% full. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

No lamp will illuminate when fault is active.

Associated Faults

SPN 1761 FMI 3, 4, and 19 (DEF: TL)			

Fault Facts

This fault may become active during control module programming. To fix this fault, finish programming and then cycle ignition switch.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low DEF tank level
- Failed DEF: TL and DEF: TT sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 759). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1761 FMI 17.

Step 2	Inspect DEF tank and lines.	Decision
Inspect DEF tank and lines for damage and leaks. Are DEF tank and lines free of damage and not leaking?		Yes: Go to Step 3. No: Repair damaged or leaking DEF tank and lines. After repairs are complete, retest for SPN 1761 FMI 17.

Step 3	Check DEF tank level.	Decision
Read DEF level using vehicle instrument panel gauge and do visual inspection of fluid level in DEF tank. Is DEF tank fluid level below half a tank?		Yes: Fill DEF tank with appropriate diesel exhaust fluid. After repairs are complete, retest for SPN 1761 FMI 17. No: Go to Step 4

Step 4	Inspect connections at DEF: TL and DEF: TT sensor.	Decision
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector. C. Check DEF: TL and DEF: TT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL and DEF: TT sensor connector, harness, and terminal clean and undamaged?		Yes: Replace DEF: TL and DEF: TT sensor. After repairs are complete, retest for SPN 1761 FMI 17. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1761 FMI 17.

End Diagnostic Steps
After performing diagnostic steps, if SPN 1761 FMI 17 remains, verify if steps were completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1761 FMI 18 - DEFTL Inducement Level 2

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid (DEF) tank level is below critical threshold. Level 2 inducement.	DEF tank level< 5.6%	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that the Diesel Exhaust Fluid (DEF) tank level is less than 5.6% full. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

No lamp will illuminate when fault is active.

Associated Faults

SPN 1761 FMI 3, 4, and 19 (DEF: TL)			

Fault Facts

This fault may become active during control module programming. To fix this fault, finish programming and then cycle ignition switch.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low DEF tank level
- Failed DEF: TL and DEF: TT sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 761). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1761 FMI 18.

Step 2	Inspect DEF tank and lines.	Decision
Inspect DEF tank and lines for damage and leaks. Are DEF tank and lines free of damage and not leaking?		Yes: Go to Step 3. No: Repair damaged or leaking DEF tank and lines. After repairs are complete, retest for SPN 1761 FMI 18.

Step 3	Check DEF tank level.	Decision
Read DEF level using vehicle instrument panel gauge and do a visual inspection of fluid level in DEF tank. Is DEF tank fluid level above half a tank?		Yes: Go to Step 4. No: Fill DEF tank with appropriate diesel exhaust fluid. After repairs are complete, retest for SPN 1761 FMI 18.

Step 4	Inspect connections at DEF: TL and DEF: TT sensor.	Decision
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector. C. Check DEF: TL and DEF: TT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL and DEF: TT sensor connector, harness, and terminal clean and undamaged?		Yes: Replace DEF: TL and DEF: TT sensor. After repairs are complete, retest for SPN 1761 FMI 18. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1761 FMI 18.

End Diagnostic Steps
After performing diagnostic steps, if SPN 1761 FMI 18 remains, verify if steps were completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1761 FMI 19 - DEFTL not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DEF: TL not detected on J1939	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

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CONTENT
UNDER
DEVELOPMENT

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See N13 Engine with SCR Diagnostic Manual 0000002161 for information on this fault code.

SPN 3031 FMI 2 - DEFTT signal erratic intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor is in range but not rational	Difference between DEF: TT sensor and Ambient Air Temperature (AAT) sensor is more than 54°F (30°C) at initial Key ON.	Key ON, after 10-hour (engine off) cold soak. Inactive: SPN 3031 FMI 3 and 4 (DEF: TT)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor is in range but not rational.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 171 (AAT)	• SPN 3031 FMI 3 and 4 (DEF: TT)		

Fault Facts

If more than one of the following sensor fail (or sets fault), suspect a common power circuit, ground circuit, or switched ignition relay problem. Following components share power and ground circuits with DEF: TL and DEF: TT sensor: NOxOUT sensor, NOxIN sensor, Ammonia (NH3) Sensor, SCR Temperature Sensor, and DOC / DPF temperature sensor.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SWBAT circuit intermittent short to GND or high resistance
- Power Distribution Module (PDM) loose fuse or relay
- GND circuit intermittent Open or high resistance
- Failed DEF: TL and DEF: TT sensor

Verify batteries are fully charged and connections are clean.

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 765). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3031 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3031 FMI 2. Is EST DTC list SPN 3031 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at PDM	Decision
A. Key OFF. B. Disconnect PDM harness connector. C. Check PDM fuses, relays, and harness connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are all fuses and relays securely attached, clean, and undamaged?		Yes: Go to Step 4. No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 3031 FMI 2.

Step 4	Inspect connections at DEF: TL and DEF: TT sensor.	Decision
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor. C. Check DEF: TL and DEF: TT harness connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL and DEF: TT sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3031 FMI 2.

Pin-Point Tests (SPN 3031 FMI 2)

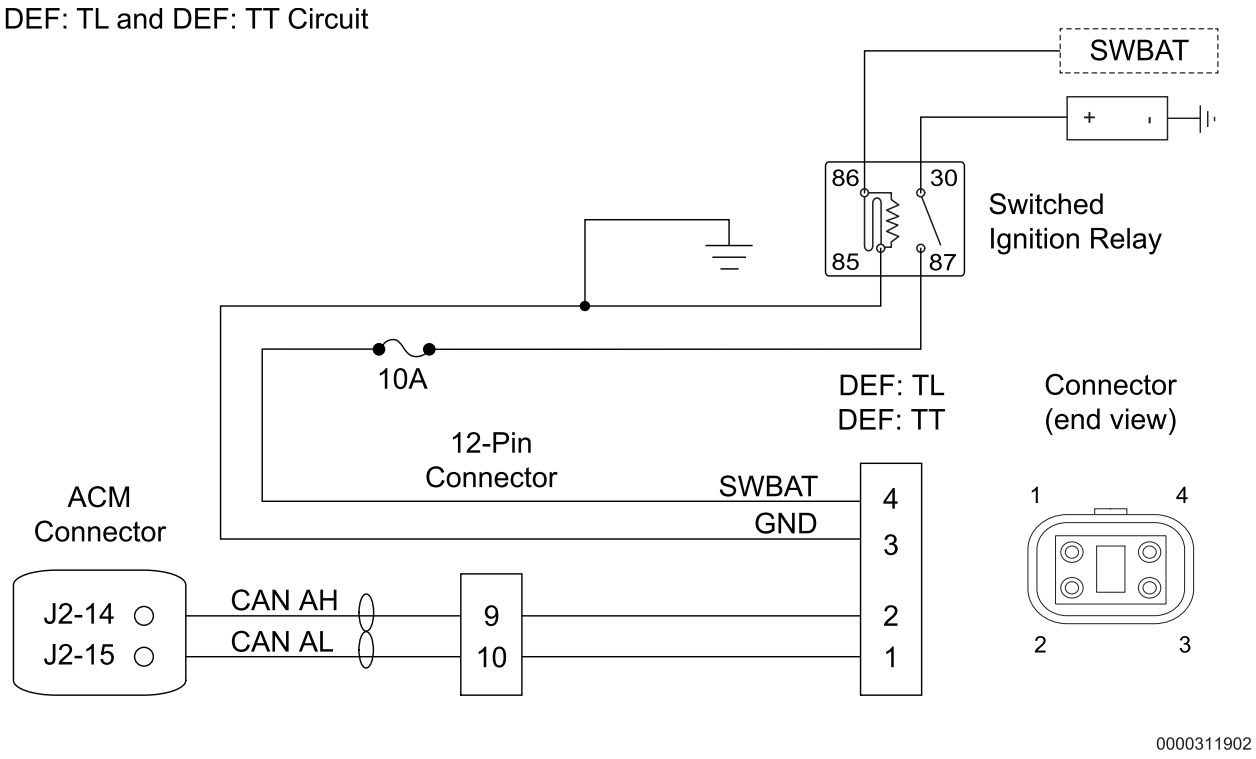
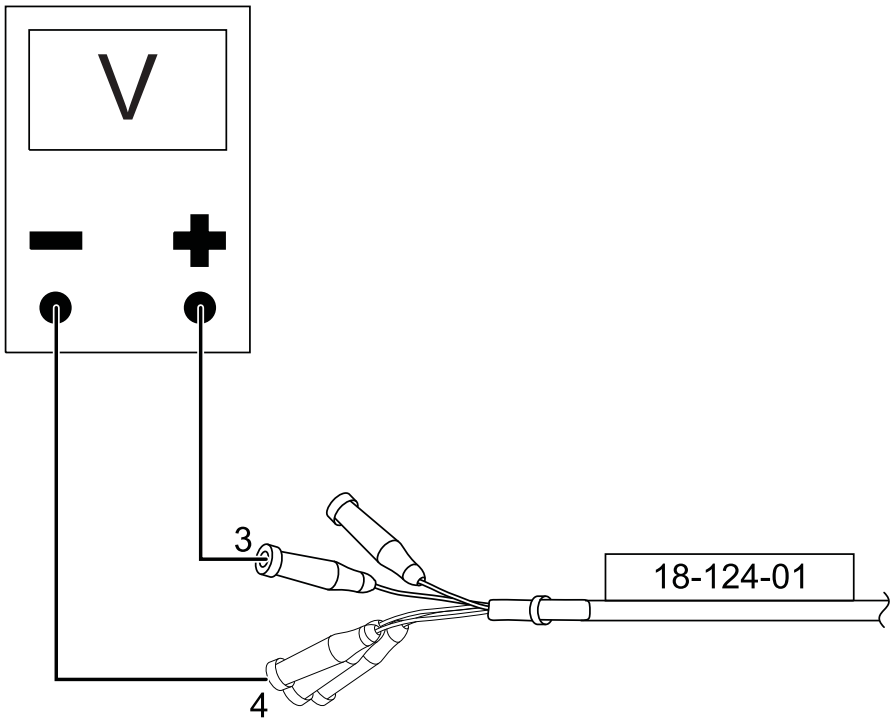


Figure 279 DEF: TL and DEF: TT Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness (DEF: TL and DEF: TT) 18-124-01
- 3-Banana Plug Breakout Harness ZTSE4498
- Digital Multimeter (DMM)



0000311881

Figure 280 Test 1 DEF: TL and DEF: TT Sensor Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector C. Connect Breakout Harness 18-124-01 to vehicle harness and leave DEF: TL and DEF: TT disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-124-01 pin-3 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace DEF: TL and DEF: TT sensor. After repairs are complete, retest for SPN 3031 FMI 2.
	No: Go to Test 2.

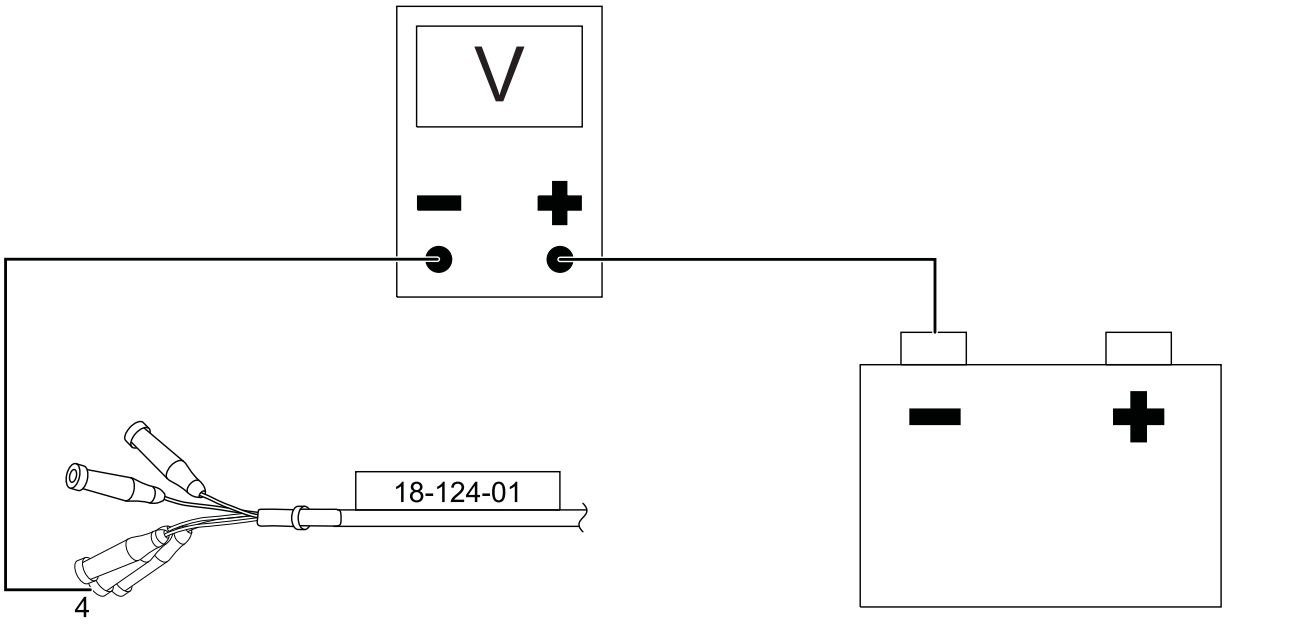


Figure 281 Test 2 DEF: TL and DEF: TT Sensor Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector C. Connect Breakout Harness 18-124-01 to vehicle harness and leave DEF: TL and DEF: TT disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-124-01 pin-4 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between DEF: TL and DEF: TT sensor module pin-3 and GND. After repairs are complete, retest for SPN 3031 FMI 2.
	No: Repair high resistance or short to GND between DEF: TL and DEF: TT sensor module pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 3031 FMI 2.

End Diagnostic Tests
After performing all tests and no problems found, verify if each step was completed correctly and proper decision was made. Return to SPN 3031 FMI 2 fault code diagnostics.

SPN 3031 FMI 3 - DEFTT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor circuit voltage above normal or shorted to high source.	Aftertreatment Control Module (ACM) detects DEF: TT sensor voltage is greater than 4.7 volts for more than 1 second.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Temperature (DEF: TT) signal voltage is greater than 4.5 volts for more than 1 second. Engine torque will be reduced if fault is active for limited period of time. Engine torque will be severely reduced after extended engine operation with fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor module

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3031 FMI 3. Is EST DTC list SPN 3031 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor module connector.	Decision
A. Key OFF. B. Disconnect DEF: TT sensor module connector. C. Check DEF: TT sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TT sensor module connector, harness, and terminals clean and undamaged?		Yes: Replace DEF: TT sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3031 FMI 3. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3031 FMI 3.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3031 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3031 FMI 4 - DEFTT signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Tank Temperature (DEF: TT) sensor circuit voltage below normal or shorted to low source.	Aftertreatment Control Module (ACM) detects DEF tank temperature signal voltage is < than 0.2 volts for more than 1 second.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid Tank Temperature (DEF: TT) signal voltage is less than 0.2 volts for more than 1 second. Engine torque will be reduced if fault is active for a limited period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DEF: TL and DEF: TT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3031 FMI 4. Is EST DTC list SPN 3031 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at DEF: TL and DEF: TT sensor connector.	Decision
A. Key OFF. B. Disconnect DEF: TL and DEF: TT sensor connector. C. Check DEF: TL and DEF: TT sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DEF: TL and DEF: TT sensor connector, harness, and terminals clean and undamaged?		Yes: Replace DEF: TL and DEF: TT sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3031 FMI 4. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3031 FMI 4.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3031 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3521 FMI 11 - Improper Reductant in DEF Tank

Condition / Description	Setting Criteria	Enable Conditions / Values
Contaminated, degraded, or incorrect Diesel Exhaust Fluid (DEF) detected.	DEF is contaminated, degraded, or incorrect	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Exhaust Fluid (DEF) is contaminated, degraded, or incorrect.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Contaminated or degraded DEF

Step 1	Check DEF quality.	Decision
	A. Obtain a sample of DEF. B. Visually inspect for contamination, and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 to 34% and not contaminated?	Yes: Retest for SPN 3521 FMI 11. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 3521 FMI 11.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3521 FMI 11 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4094 FMI 31- DEF below acceptable quality

Condition / Description	Setting Criteria	Enable Conditions / Values
Incorrect Diesel Exhaust Fluid (DEF) is detected.	Nitrogen Oxide (NOx) OUT is greater than expected	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Nitrogen Oxide (NOx) OUT is seeing greater NOx than expected within calibrated time after Diesel Exhaust Fluid (DEF) has been injected into exhaust.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3216 (NOx IN)	• SPN 3218 (NOxIN)	• SPN 3226 (NOxOUT)	• SPN 3228 (NOxOUT)
• SPN 3361 FMI 2, 3, and 4 (DEF: SP)	• SPN 3362 FMI 31 (DEF: SP)	• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 4334 FMI 2, 16 and 18 (DEF: AP)
• SPN 4340 FMI 3 and 5 (DEF: L1HC)	• SPN 4342 FMI 3 and 5 (DEF: L2HC)	• SPN 4344 FMI 3 and 5 (DEF: L3HC)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)
• SPN 4363 FMI 2, 3, and 4 (SCROT)	• SPN 4377 (NH3)	• SPN 4380 (NH3)	• SPN 4382 (NH3)
• SPN 5394 FMI 5 and 7 (DEF: DU)	• SPN 5742 (DOC / DPF Temp)	• SPN 5743 (SCR Temp)	• SPN 5745 (DEF: SMH)
• SPN 5746 (DEF: SMH)	• SPN 5798 (DEF: SMH Relay)	• SPN 520668 (AFT system)	• SPN 520669 (AFT system)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF tank, supply module, or doser unit line; or loose, leaking, damaged, or restricted connection
- Contaminated or degraded DEF
- Failed Diesel Exhaust Fluid Doser Unit (DEF: DU)

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 776). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4094 FMI 31.

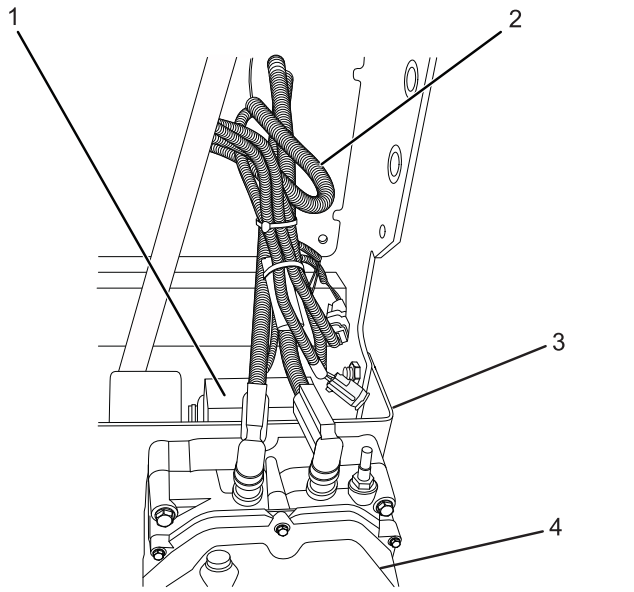


Figure 282 DEF Supply Module Location Typical

1. DEF lines
2. DEF tank bracket
3. DEF supply module
4. DEF supply module

Step 2	Inspect connections at Diesel Exhaust Fluid (DEF) tank.	Decision
A. Key OFF. B. Check DEF tank, DEF supply module, and DEF: DU lines and connections for: cracks and pitting; loose, leaking, or damaged connections; and restrictions. Are DEF tank, DEF supply module, and DEF: DU lines and connections in good condition and unrestricted?		Yes: Go to Step 3. No: Repair or replace failed line or connection. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4094 FMI 31.

Step 3	Check DEF quality.	Decision
Obtain a sample of DEF. Visually inspect for contamination, and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30% and 34%, and not contaminated?		Yes: Go to Step 4. No: Drain DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4094 FMI 31.

Step 4	Check DEF Dosing Unit (DEF: DU) operation.	Decision
Using EST with ServiceMaxx™ software, perform KOEO DEF Supply Pump Override Test (page 2165). Is DEF: DU operating correctly?		Yes: Replace NOxOut sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4094 FMI 31. No: Replace DEF supply module filter and clean DEF supply module using 18-200-01. Repeat Step 7. If DEF: DU still does not operate correctly, replace DEF: DU. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4094 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4094 FMI 31 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5246 FMI 15 - SCR Tamper Proof Inducement Level 1 status

Condition / Description	Setting Criteria	Enable Conditions / Values
Detects an Open circuit in the aftertreatment system.	No signal return from an aftertreatment component	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that any Aftertreatment (AFT) sensor or actuator is Open or disconnected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

Any Aftertreatment Open circuit faults			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- AFT sensor or actuator circuit Open or disconnected

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 780). Are any Associated Faults active?		Yes: Repair active Associated Faults. After repairs are complete, retest for SPN 5246 FMI 15.

End Diagnostic Steps
After performing diagnostic step, if SPN 5246 FMI 15 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

DEF: SMH Relay (Diesel Exhaust Fluid Supply Module Heater Relay)

Overview of DEF: SMH Relay Sensor Group

SPN	FMI	Description
5746	3	DEF Supply Module Heater Relay short to PWR (page 783)
5746	4	DEF Supply Module Heater Relay short to GND (page 793)

Overview

Diesel Exhaust Fluid Supply Module HTR Relay (DEF: SMH Relay) is used to control DEF Supply Module Heater (DEF: SMH), which is installed in DEF supply module. Aftertreatment Control Module (ACM) turns DEF: SMH on by controlling DEF: SMH Relay PWR.

SPN 5746 FMI 3 - DEF Supply Module Heater Relay short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Module Heater Relay (DEF: SMH Relay) circuit is shorted to power, open, or high resistance.	Resistance between DEF: SMH Relay CTL and DEF: SMH Relay GND > 500,000 ohms, or DEF: SMH Relay control is shorted to power	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects voltage signal from Diesel Exhaust Fluid Supply Module Heater Relay (DEF: SMH Relay) is lower than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SMH Relay CTL circuit short to PWR
- DEF: SMH Relay CTL circuit Open or high resistance
- DEF: SMH Relay GND circuit Open or high resistance
- Failed DEF: SMH Relay

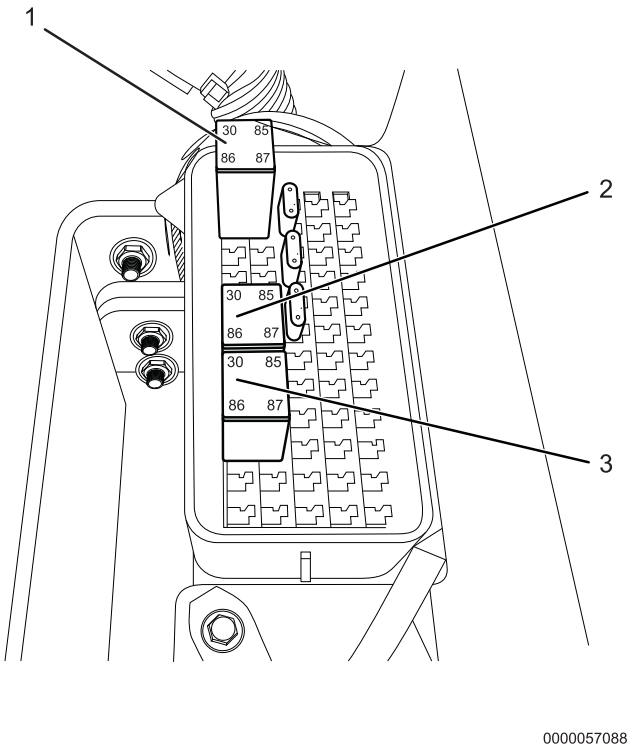


Figure 283 DEF: SMH Relay Location (Typical)

1. DEF: LHR
2. DEF: SMH Relay
3. Switched ignition relay

Step 1	Inspect connections at Power Distribution Module (PDM).	Decision
A. Key OFF. B. Check PDM, fuses, and relays for blown fuses and loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?		Yes: Go to Step 2. No: Repair PDM, fuses, and / or relays. After repairs are complete, retest for SPN 5746 FMI 3.

Step 2	Inspect connections at Aftertreatment Control Module (ACM).	Decision
A. Key OFF. B. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Leave connector J2 unplugged. Are ACM connectors, harnesses, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5746 FMI 3.

Pin-Point Tests (SPN 5746 FMI 3)

DEF: SMH Circuit

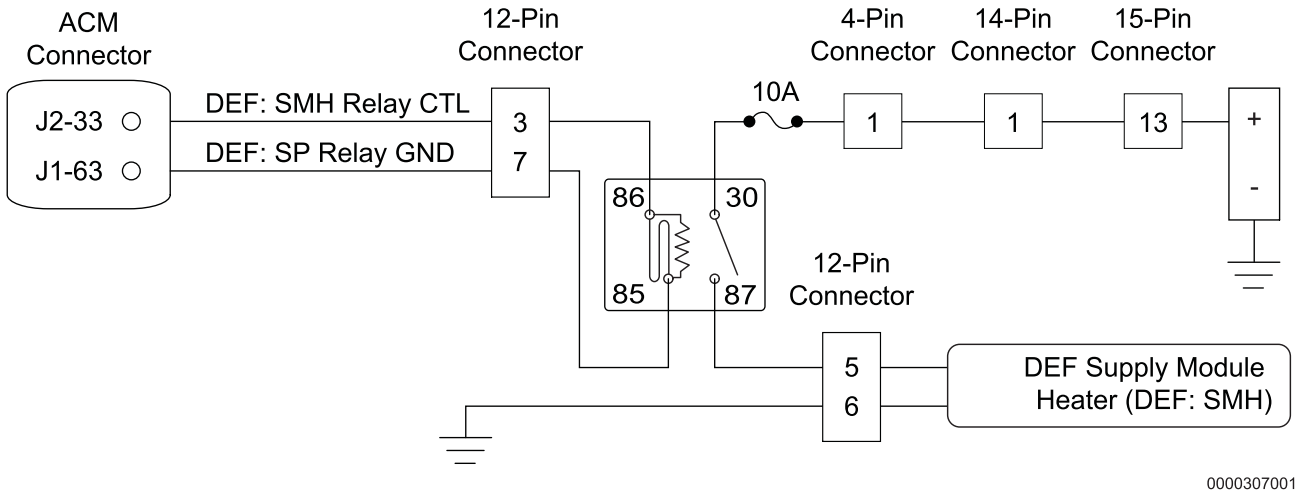
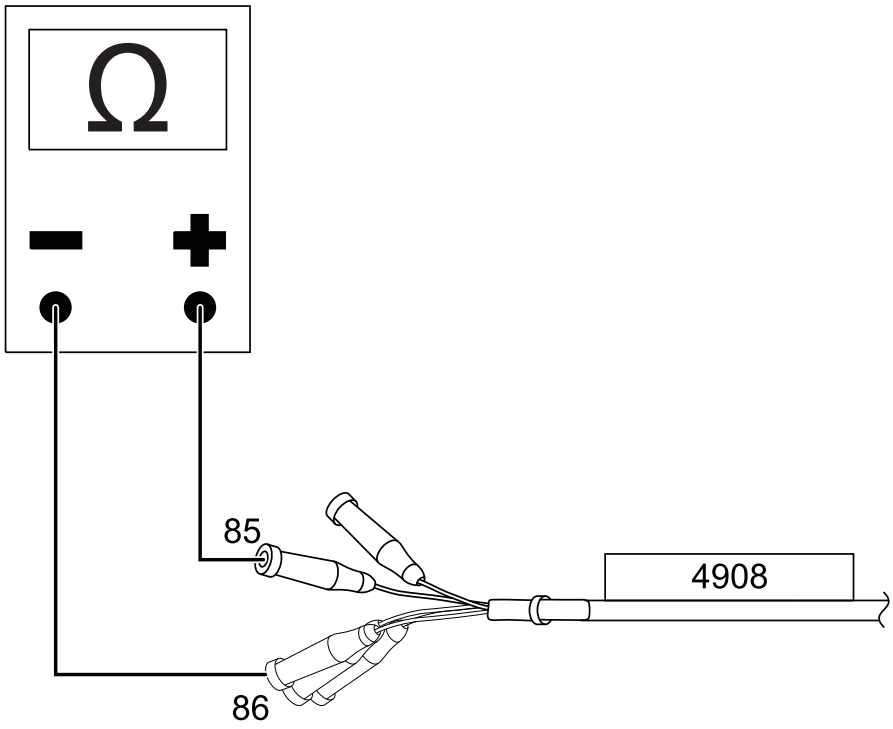


Figure 284 DEF: SMH Relay Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- 180-pin Breakout Box 00-00956-08
- Breakout Harness 18-537-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)



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Figure 285 Test 1 DEF: SMH Relay Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Remove DEF: SMH Relay. C. Install the DEF: SMH Relay into Breakout Harness ZTSE4908.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Less than 300 ohms
Decision	
Is resistance less than 300 ohms?	Yes: Go to Test 2.
	No: Replace DEF: SMH Relay. After repairs are complete, retest for SPN 5746 FMI 3.

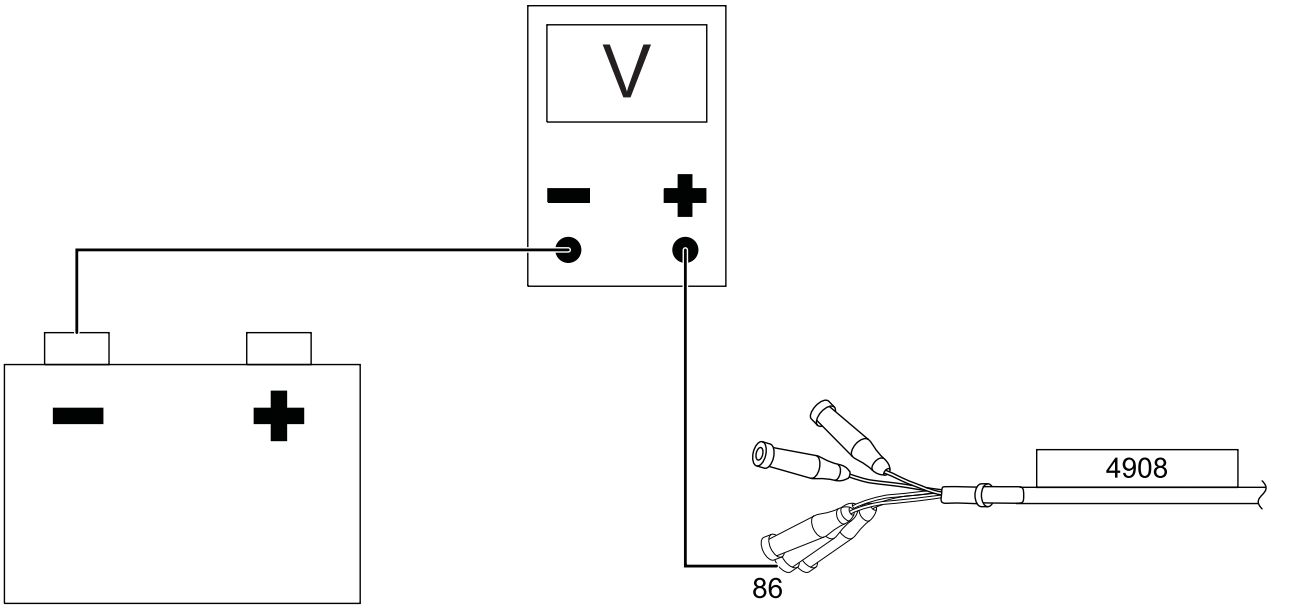


Figure 286 Test 2 DEF: SMH Relay Circuit Voltage Check

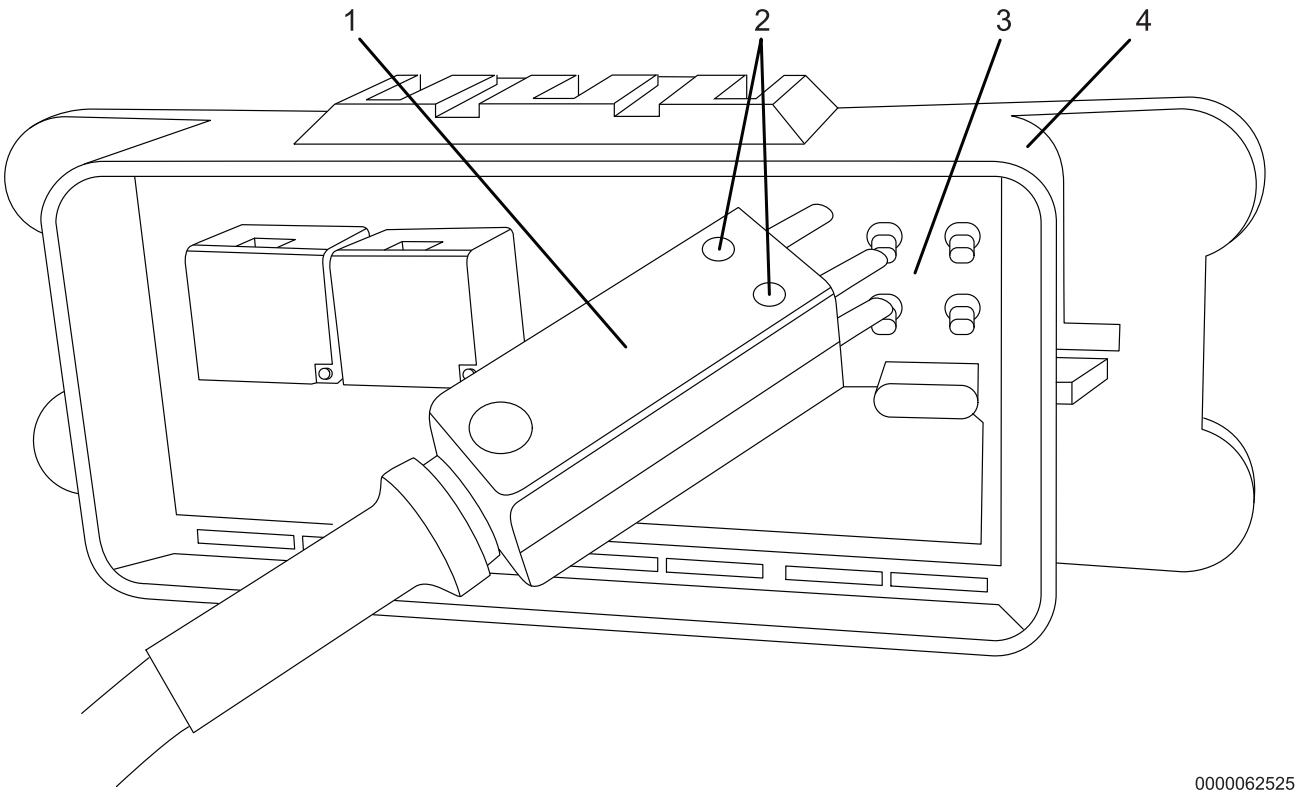


Figure 287 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF.
B. Connect Breakout Harness ZTSE4908 to Power Distribution Module (PDM) and leave DEF: SMH Relay disconnected.
C. Disconnect connector J2 from Aftertreatment Control Module (ACM).
D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-86 and known good ground.	Less than 0.5 volt.
Decision	
Is voltage less than 0.5 volt?	Yes: Go to Test 3.
	No: Repair short to PWR between DEF: SMH Relay pin-86 and ACM pin J2-33. After repairs are complete, retest for SPN 5746 FMI 3.

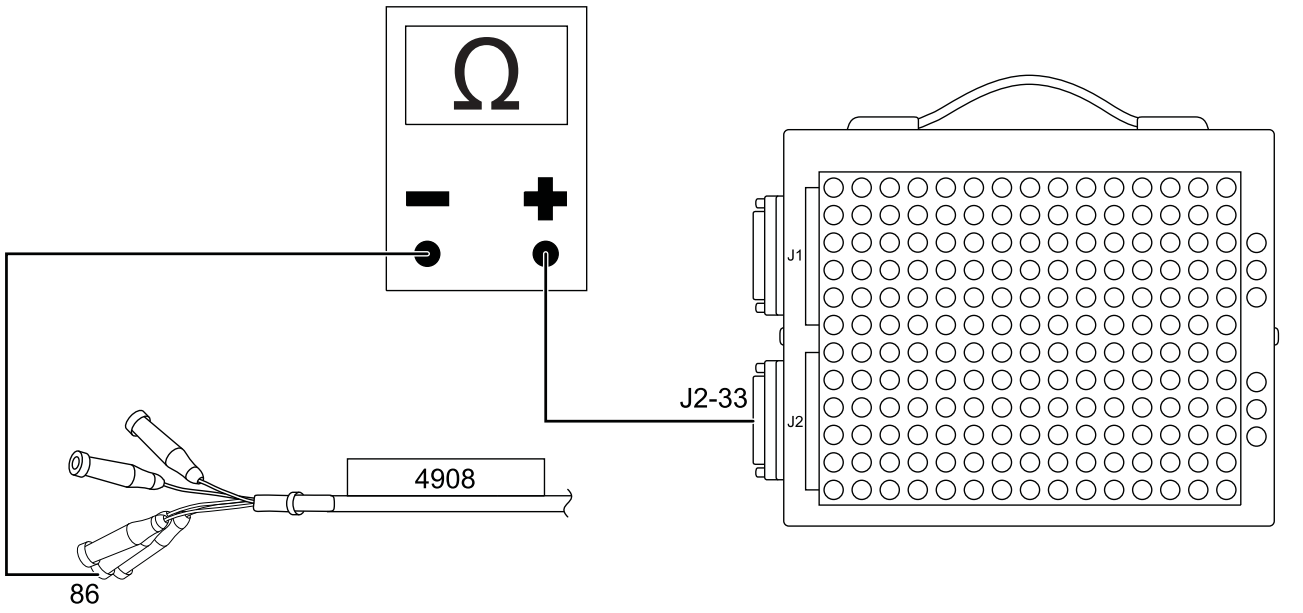


Figure 288 Test 3 DEF: SMH Relay Circuit Resistance Check

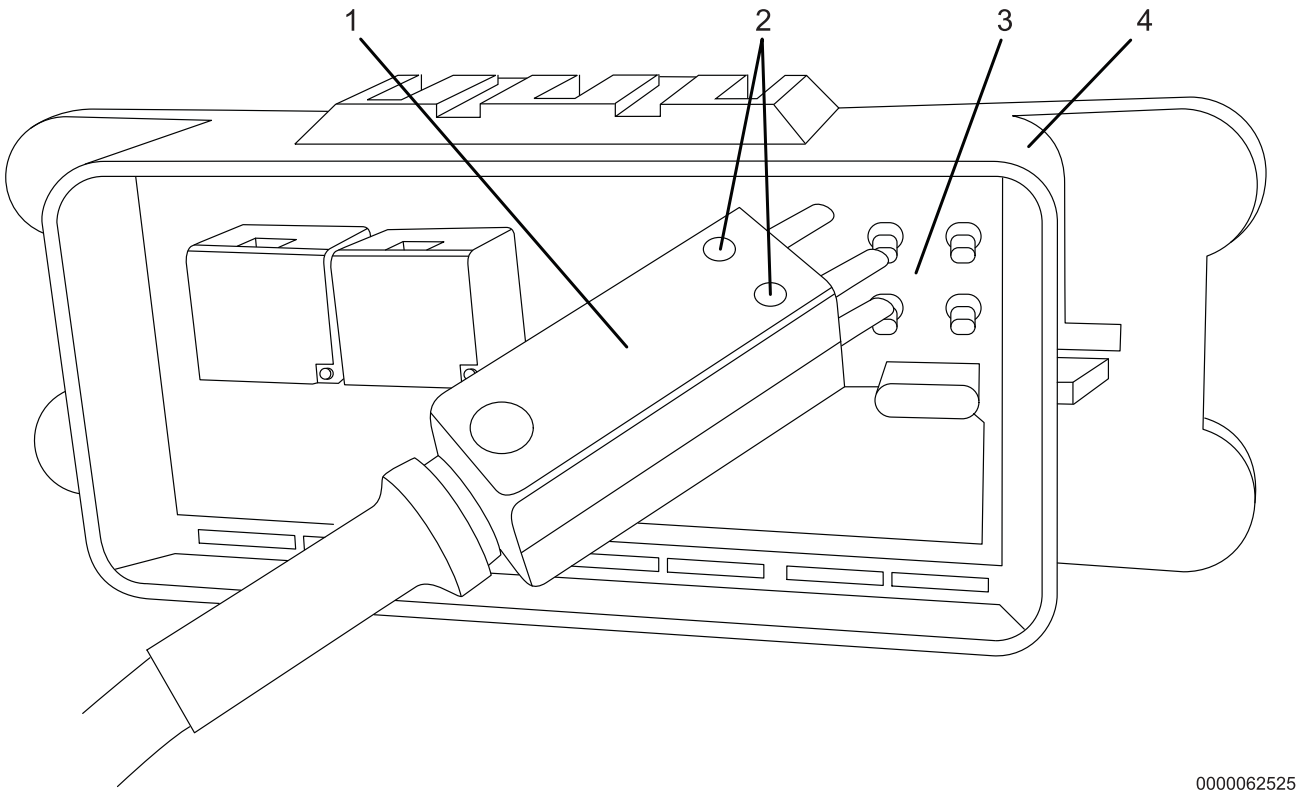


Figure 289 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 3 Setup
A. Key OFF.
B. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box 00-00956-08.
C. Connect Breakout Harness 18-537-01 to J2 vehicle harness connector and leave ACM disconnected.
D. Connect Breakout Harness ZTSE4908 to PDM and leave DEF: SMH Relay disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-86 and 180-pin Breakout Box pin J2-33.	Less than 5 ohms.
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open or high resistance between DEF: SMH Relay pin-85 and ACM pin J1-63. After repairs are complete, retest for SPN 5746 FMI 3.
	No: Repair Open or high resistance between DEF: SMH Relay pin-86 and ACM pin J2-33. After repairs are complete, retest for SPN 5746 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to 5746 FMI 3 fault code diagnostics.

SPN 5746 FMI 4 - DEF Supply Module Heater Relay short to GND

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) Relay circuit voltage is below normal or shorted to ground.	Resistance between DEF: SMH Relay control and DEF: SMH Relay ground < 0.2 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects signal voltage from Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) Relay is lower than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DEF: SMH Relay CTL circuit short to GND
- DEF: SMH Relay GND circuit shorted to DEF: SMH Relay CTL circuit
- Failed DEF: SMH Relay

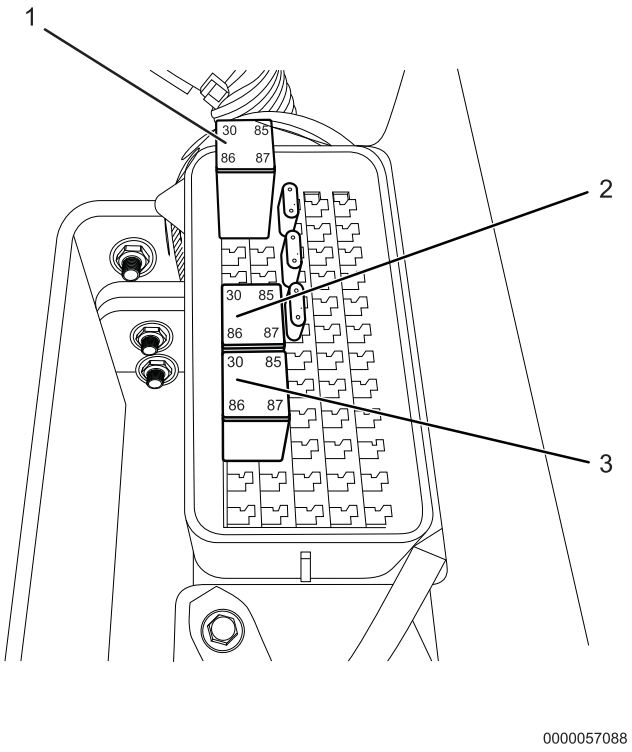


Figure 290 DEF: SMH Relay Location (Typical)

1. Diesel Exhaust Fluid Line Heater Relay (DEF: LHR)
2. Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) Relay
3. Switched ignition relay

Step 1	Inspect connections at Power Distribution Module (PDM).	Decision
A. Key OFF. B. Check PDM, fuses, and relays for blown fuses and loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?		Yes: Perform Pin-Point Tests. No: Repair PDM, fuses, and / or relays. After repairs are complete, retest for SPN 5491 FMI 4.

Pin-Point Tests (SPN 5746 FMI 4)

DEF: SMH Circuit

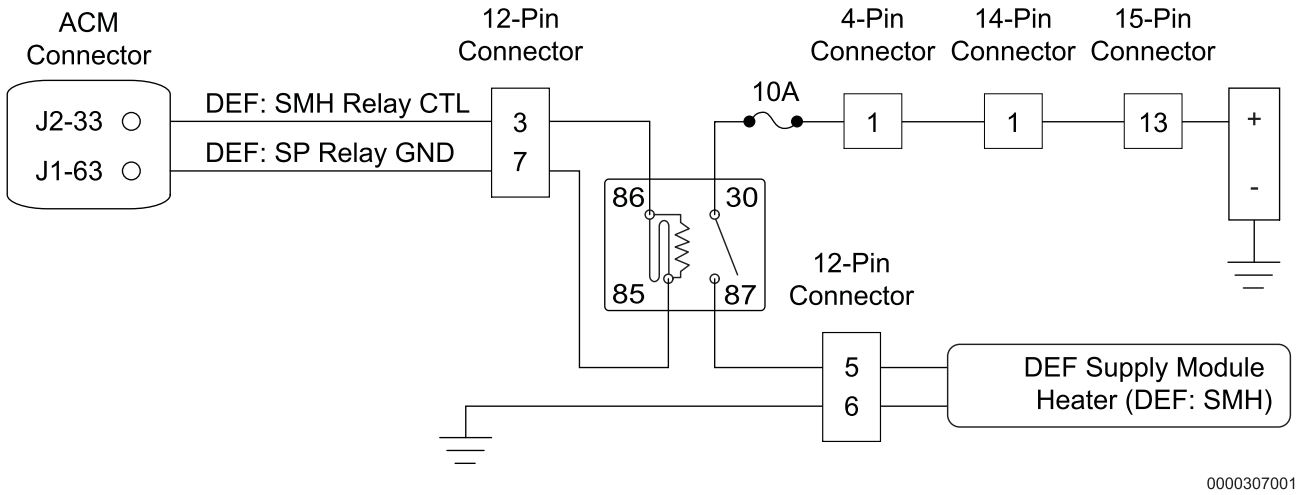
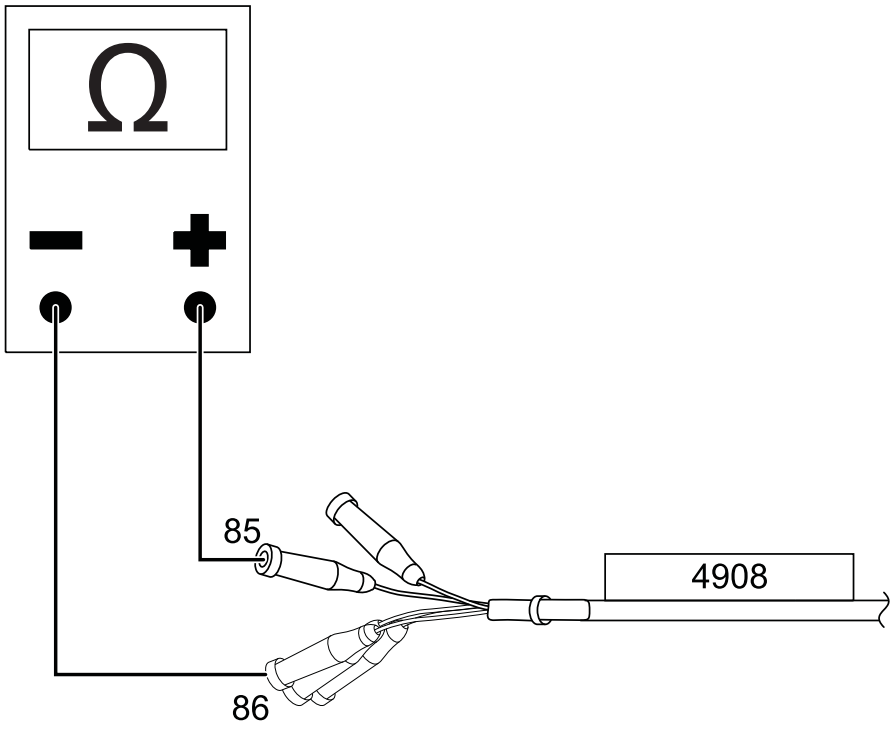


Figure 291 DEF: SMH Relay Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

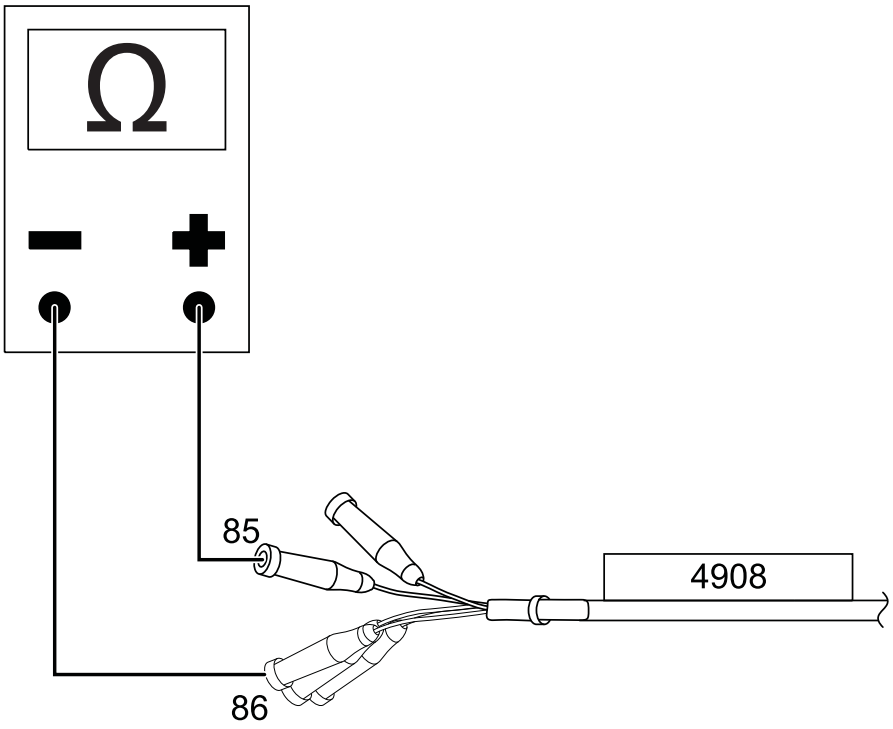


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Figure 292 Test 1 DEF: SMH Relay Resistance Check

Test 1 Setup
A. Key OFF. B. Remove Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) Relay. C. Install DEF: SMH Relay into Breakout Harness ZTSE4908.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Between 100 and 300 ohms
Decision	
Is resistance between 100 and 300 ohms?	Yes: Go to Test 2.
	No: Replace DEF: SMH Relay. After repairs are complete, retest for SPN 5746 FMI 4.



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Figure 293 Test 2 DEF: SMH Relay Circuit Resistance Check

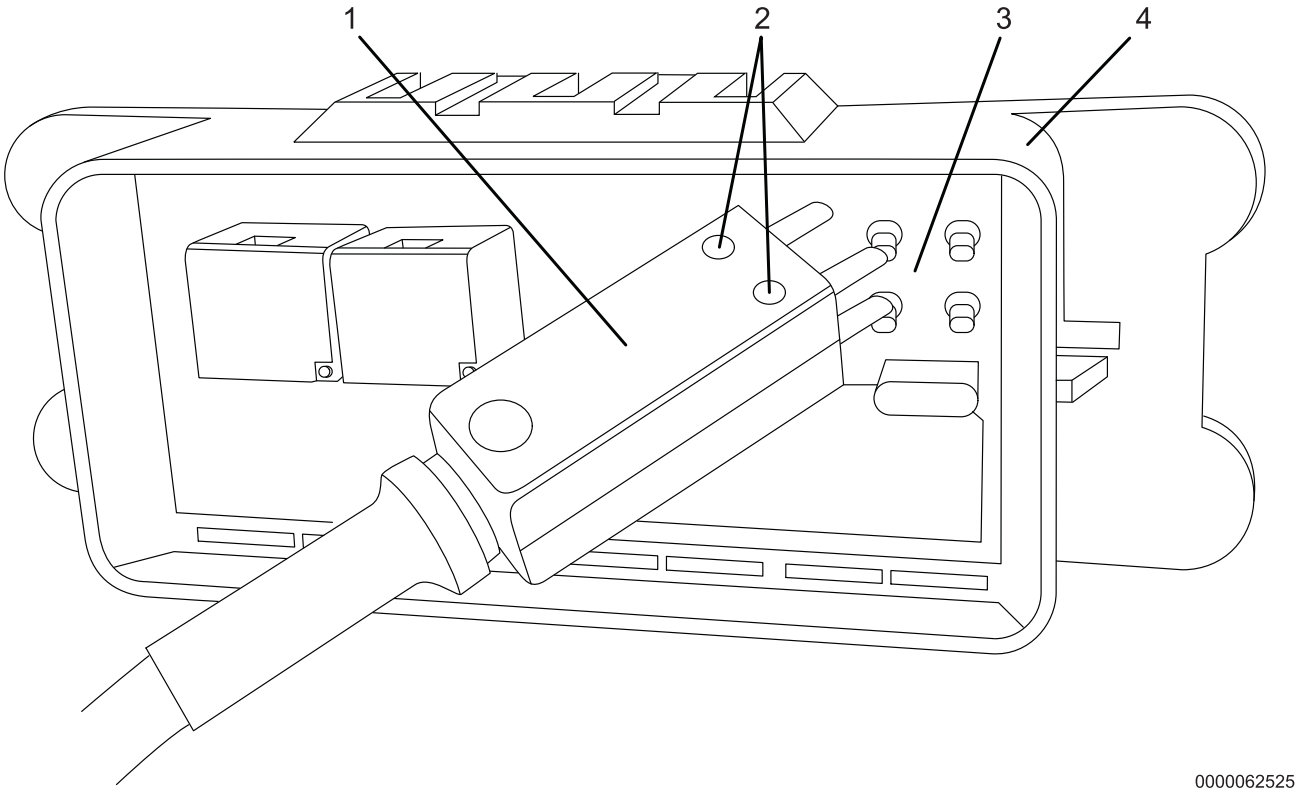


Figure 294 Installation of Breakout Harness ZTSE4908 (typical)

1. Breakout Harness ZTSE4908
2. Dimples
3. Relay socket
4. PDM

CAUTION: For correct diagnosis, Breakout Harness ZTSE4908 must be installed with installation dimples toward top of PDM. Reversed installation will result in incorrect measurements.

Test 2 Setup
A. Key OFF.
B. Remove Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) Relay.
C. Install DEF: SMH Relay into Breakout Harness ZTSE4908.
D. Connect Breakout Harness ZTSE4908 to PDM.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4908 pin-85 and pin-86.	Less than 100 ohms
Decision	
Is resistance less than 100 ohms?	Yes: Repair short between DEF: SMH Relay CTL circuit and DEF: SMH Relay GND circuit. After repairs are complete, retest for SPN 5746 FMI 4.
	No: Repair short to GND in between DEF: SMH Relay pin-86 and ACM pin J2-33. After repairs are complete, retest for SPN 5746 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to 5746 FMI 4 fault code diagnostics.

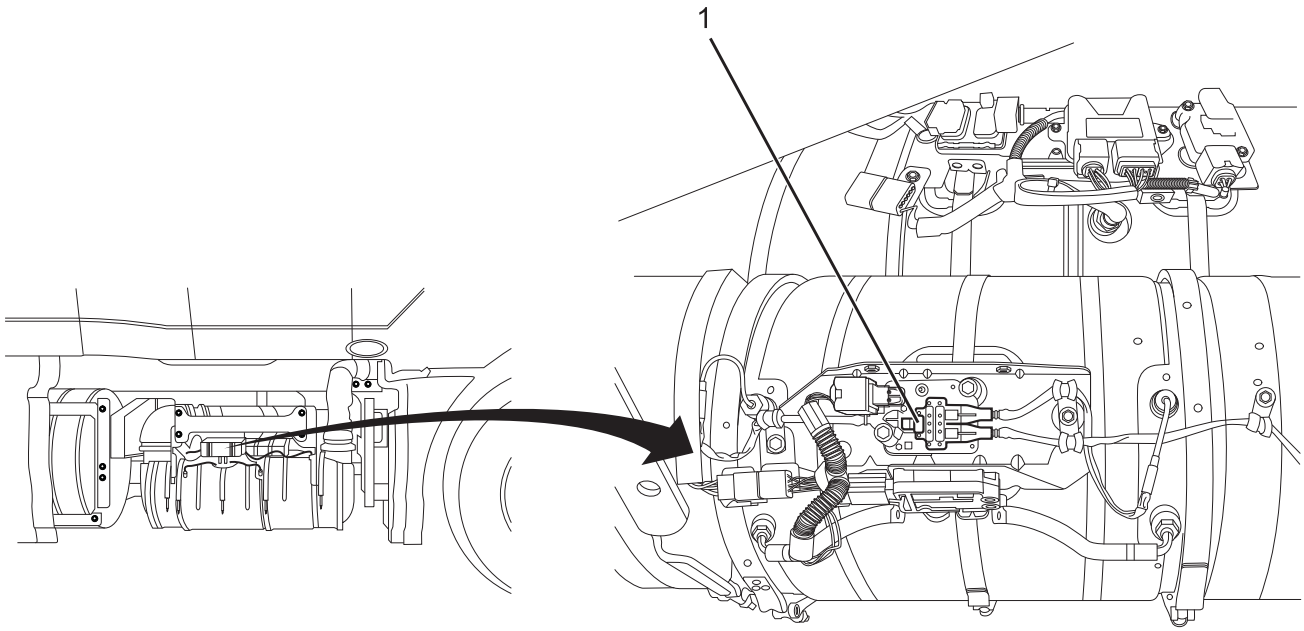
DOC Temperature Sensor Module

Overview of DOC / DPF Temperature Sensor Group

SPN	FMI	Description
5742	3	DPF Thermocouple Controller Out of Range HIGH (page 801)
5742	4	DPF Thermocouple Controller Out of Range LOW (page 806)
5742	11	DPF Thermocouple Controller signal erratic, intermittent, or incorrect (page 811)
5742	16	DPF Thermocouple Controller above Maximum Temperature (page 817)
5742	19	DOC/DPF Temperature module not detect J1939 (page 819)

Overview

DOC / DPF temperature sensor module monitors aftertreatment Diesel Particulate Filter (DPF) and Diesel Oxidation Catalyst (DOC) temperature. DOC / DPF temperature sensor module monitors signals from DOC Intake Temperature (DOCIT), DPF Intake Temperature (DPFIT), and DPF Outlet Temperature (DPFOT) sensors, and communicates these signals to Aftertreatment Control Module (ACM) over Controller Area Network (CAN). Engine torque will be reduced and vehicle speed may be limited after extended engine operation with faults active.



0000054373

Figure 295 DOC / DPF Temperature Sensor Module Location

1. DOC / DPF Temperature Sensor Module

SPN 5742 FMI 3 - DPF Thermocouple Controller Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
The Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module has detected high supply voltage.	DOC / DPF temperature sensor module supply voltage > 18 volts ± 1 volt	Key ON

Fault Overview

The fault code sets when the Aftertreatment Control Module (ACM) detects the DOC / DPF temperature sensor module supply voltage is high for a period of 3.8 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Incorrect battery wiring (series instead of in parallel)
- Charging voltage is excessive
- Failed DOC / DPF temperature sensor module

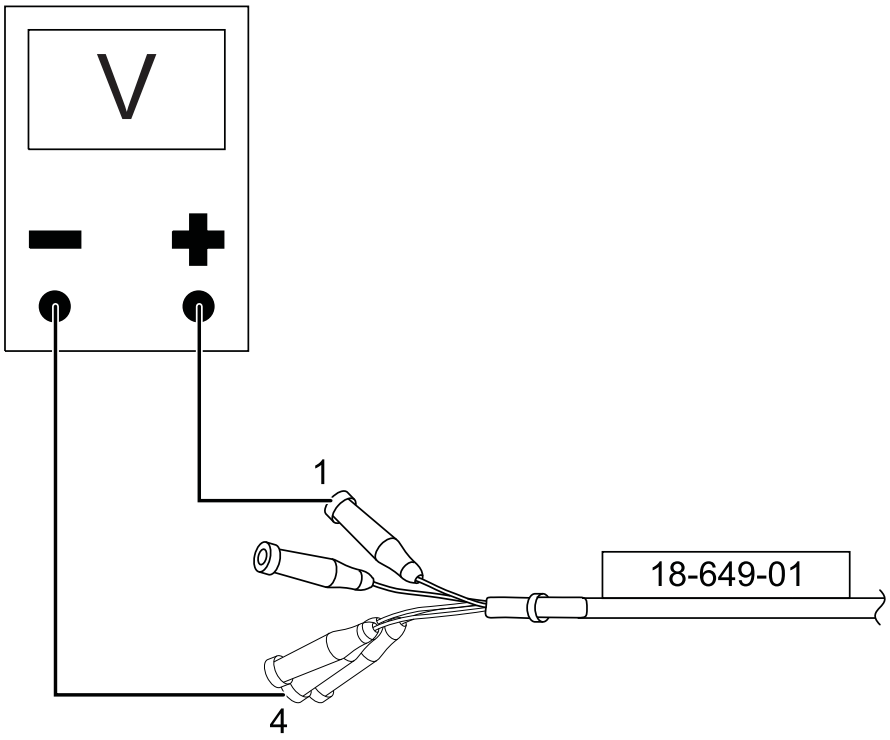
Step 1	Inspect connections at Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
A. Key OFF. B. Disconnect DOC / DPF sensor module connector. C. Check DOC / DPF sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DOC / DPF sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5742 FMI 3.

Pin-Point Tests (SPN 5742 FMI 3)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 296 Test 1 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module C. Connect Breakout Harness 18-649-01 to vehicle harness connector and leave DOC / DPF temperature sensor module disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace DOC /DPF temperature sensor module. After repairs are complete, retest for SPN 5742 FMI 3.
	No: Repair incorrect battery wiring. After repairs are complete, retest for SPN 5742 FMI 3

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5742 FMI 3 fault code diagnostics.

SPN 5742 FMI 4 - DPF Thermocouple Controller Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
The Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module has detected low supply voltage.	DOC / DPF temperature sensor module supply voltage < 6.3 volts ± 0.3 volt	Key ON

Fault Overview

The fault code sets when the Aftertreatment Control Module (ACM) detects the Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module supply voltage is low for a period of 3.8 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- GND circuit intermittent open or high resistance
- SWBAT circuit intermittent short to ground or Open
- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module

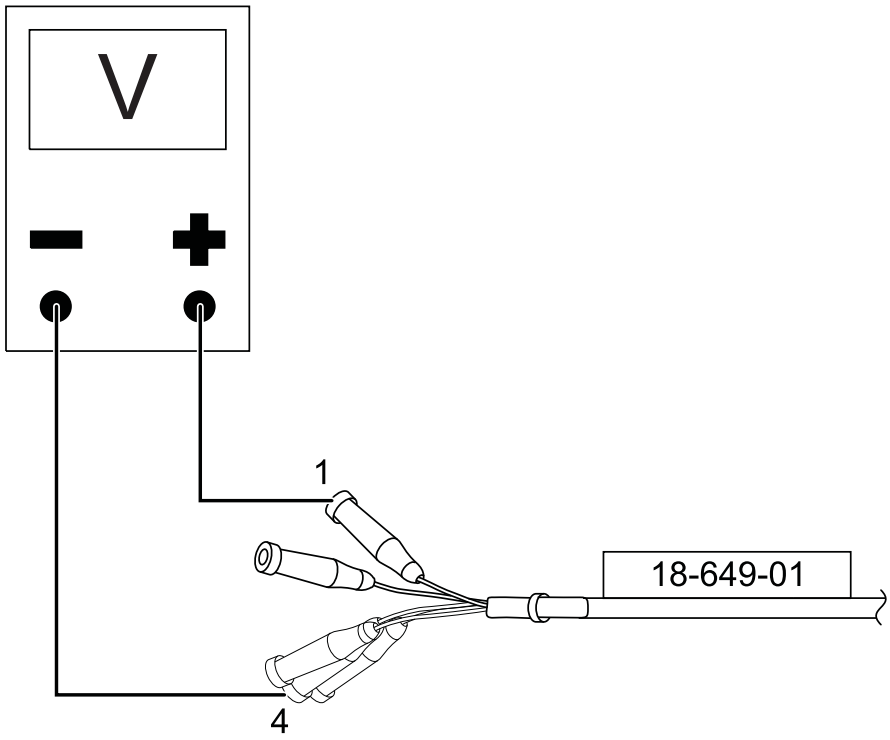
Step 1	Inspect connections at Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module connector. C. Check DOC / DPF temperature sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DOC / DPF temperature sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5742 FMI 4.

Pin-Point Tests (SPN 5742 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 297 Test 1 DOC / DPF Temperature Sensor Module Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module C. Connect Breakout Harness 18-649-01 to vehicle harness connector and leave DOC / DPF temperature sensor module disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 5742 FMI 4.
	No: Go to Test 2.

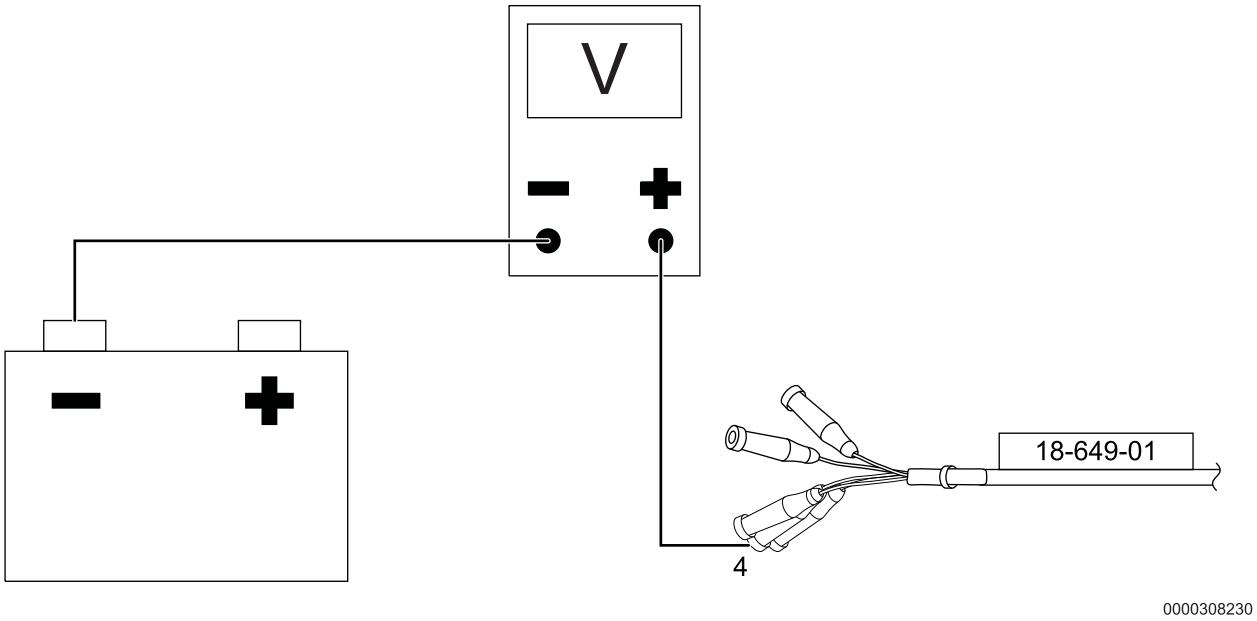


Figure 298 Test 2 DOC / DPF Temperature Sensor Module Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module C. Connect Breakout Harness 18-649-01 to vehicle harness connector and leave DOC / DPF temperature sensor module disconnected. D. Key-On Engine-Off (KOEO).

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-4 and a known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance in ground circuit between DOC / DPF temperature sensor module connector pin-1 and ground. After repairs are complete, retest for SPN 5742 FMI 4.
	No: Repair Open or short to ground in Switch Battery (SWBAT) circuit between DOC / DPF temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5742 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5742 FMI 4 fault code diagnostics.

SPN 5742 FMI 11 - DPF Thermocouple Controller signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module has detected an intermittent power supply voltage drop that results in a reset internal to the module.	DOC / DPF temperature sensor module > 302°F (150°C) and the number of DOC / DPF temperature sensor module power reset events within a 300 second window is ≥ 5 counts.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects number of DOC / DPF temperature sensor module power reset events within a 300 second window is greater than or equal to 5 counts. Active and parked regeneration is disabled. Exhaust Gas Recirculation (EGR) valve operation will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing, damaged, or restricted air flow across Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module
- SWBAT circuit intermittent Open or short to GND
- GND circuit intermittent Open or short to PWR
- Failed DOC/DPF temperature sensor module

Step 1	Inspect for blockages or damage at Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module heat shield.	Decision
A. Disconnect DOC/DPF temperature sensor module connector. B. Check for air flow restrictions around DOC/DPF temperature sensor module (mud, aftermarket shields, flaps, or brackets installed. Is DOC / DPF temperature sensor module heat shield free of air restrictions and not missing or damaged?		Yes: Go to Step 2. No: Remove air restriction, or replace or repair DOC/DPF temperature sensor module heat shield. After repairs are complete, retest for SPN 5742 FMI 11.

Step 2	Inspect connections at DOC / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
A. Key OFF. B. Disconnect DOC/DPF temperature sensor module connector. C. Check DOC/DPF temperature sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DOC/DPF temperature sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5742 FMI 11.

Pin-Point Tests (SPN 5742 FMI 11)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)

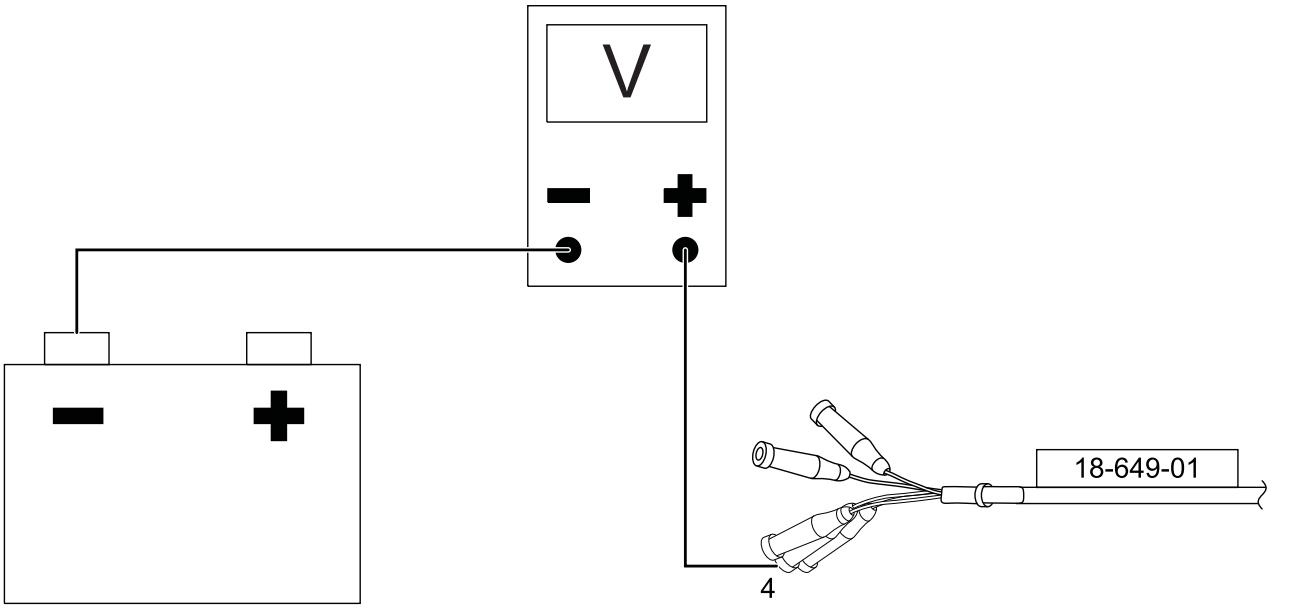
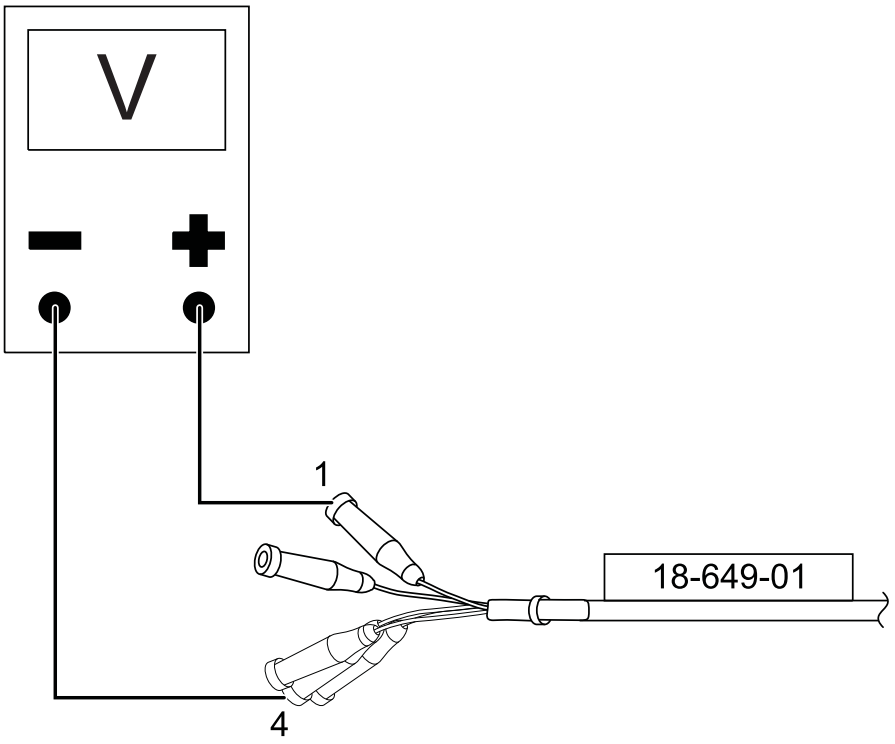


Figure 299 Test 1 DOC/DPF Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Verify batteries are fully charged and connections are clean. B. Key OFF. C. Disconnect DOC / DPF temperature sensor module D. Connect Breakout Harness 18-649-01 to vehicle harness connector and leave DOC / DPF temperature sensor module disconnected. E. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-4 and a known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open or short to GND in switched battery circuit between DOC/DPF temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5742 FMI 11.



0000308227

Figure 300 Test 2 DOC/DPF Temperature Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module C. Connect Breakout Harness 18-649-01 to vehicle harness connector and leave DOC / DPF temperature sensor module disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4 (wiggle if necessary).	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace DOC/DPF temperature sensor module. After repairs are complete, retest for SPN 5742 FMI 11.
	No: Repair intermittent, Open or short to PWR in GND circuit between DOC/DPF temperature sensor module connector pin-1 and GND. After repairs are complete, retest for SPN 5742 FMI 11.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5742 FMI 11 fault code diagnostics.

SPN 5742 FMI 16 – DPF Thermocouple Controller above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module data valid, but above normal operating range (moderately severe level). Signal has exceeded the maximum temperature limit.	DOC / DPF temperature sensor module > 302°F (150°C)	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module signal is greater than 302°F (150°C) for 4.2 seconds. Active and parked regeneration is disabled. Exhaust Gas Recirculation (EGR) valve operation will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during consecutive drive cycles.

Associated Faults

• SPN 3242 FMI 0, 15, and 16 (DPFIT)	• SPN 3246 FMI 0, 15, and 16 (DPFOT)	• SPN 4765 FMI 16 (DOCIT)	

Fault Facts

This fault will go inactive after the DOC / DPF temperature sensor module temperature drops below the warning limit, and will likely be inactive when the vehicle is in the shop. For this reason, these diagnostics must be used for both active and inactive fault codes. Inspect for overheated aftertreatment components, cracked exhaust system welds, leaking exhaust system seams, or other damage.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing, damaged, or restricted air flow across Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module
- Exhaust leak(s)
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 817). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5742 FMI 16.

Step 2	Inspect for blockages or damage at Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module heat shield.	Decision
A. Disconnect DOC / DPF temperature sensor module connector. B. Check for air flow restrictions around DOC / DPF temperature sensor module (mud, aftermarket shields, flaps, or brackets installed. Is DOC / DPF temperature sensor module heat shield free of air restrictions and not missing or damaged?		Yes: Go to Step 3. No: Remove air restriction, or replace or repair DOC / DPF temperature sensor module heat shield. After repairs are complete, retest for SPN 5742 FMI 16.

Step 3	Inspect exhaust system.	Decision
Inspect exhaust system for leaks and physical damage. Is the exhaust system free of leaks and physical damage?		Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 5742 FMI 16. No: Repair or replace damaged exhaust components. Refer to Fault Facts. After repairs are complete, retest for SPN 5742 FMI 16.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5742 FMI 16 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 5742 FMI 19 - DOC/DPF Temperature module not detect J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DPF temperature sensor module not detected on J1939 Controller Area Network (CAN).	Aftertreatment Control Module (ACM) loses J1939 data link communications with Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Key ON

Fault Overview

The fault code sets when the Aftertreatment Control Module (ACM) loses J1939 data link communications with the DOC / DPF temperature sensor module during two events.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

If more than one of the following sensor modules fail (or set a fault), suspect a common power circuit, ground circuit, or switched ignition relay problem. The following components share power and ground circuits: DOC / DPF temperature sensor module, SCR temperature sensor module, NH3 sensor module, NOx OUT sensor module, NOx IN sensor module, and DEFTLT sensor module.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Switched battery circuit short to ground or open
- Controller Area Network (CAN)-AH circuit open or short to ground
- CAN-AL circuit open or short to ground
- CAN-AH circuit short to power
- CAN-AL circuit short to power
- GND circuit open or high resistance
- CAN-AH short to CAN-AL
- Failed DOC / DPF temperature sensor module

Verify batteries are fully charged and connections are clean.

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5742 FMI 19. Does EST DTC list show SPN 5742 FMI 19 as active?		Yes: Go to Step 2. No: Drive vehicle and retest for SPN 5742 FMI 19. If fault code does not return, notify supervisor for further action.

Step 2	Inspect connections at Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
A. Key OFF. B. Disconnect DOC / DPF temperature sensor module connector. C. Check DOC / DPF temperature sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the DOC / DPF temperature sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5742 FMI 19.

Pin-Point Tests (SPN 5742 FMI 19)

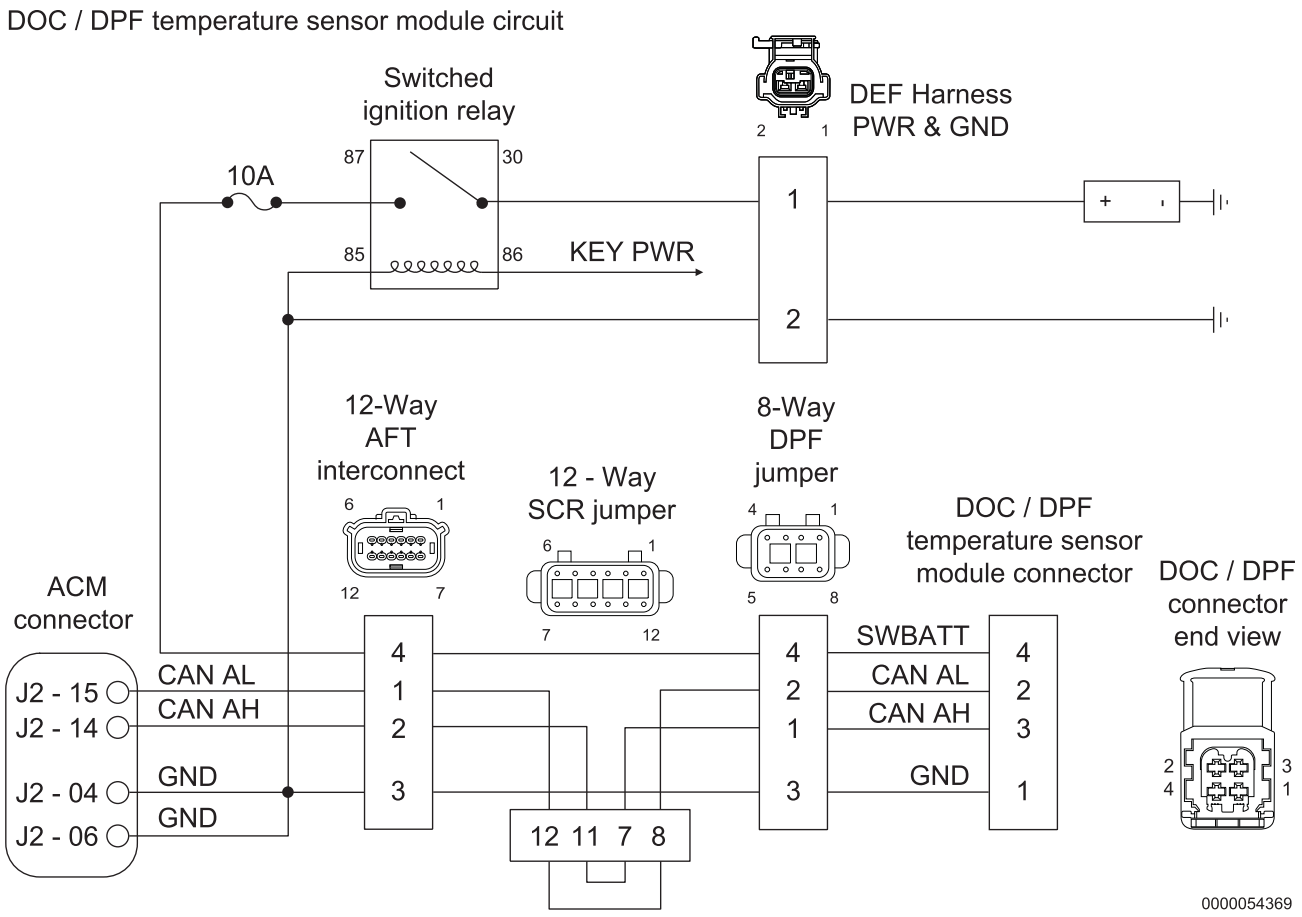
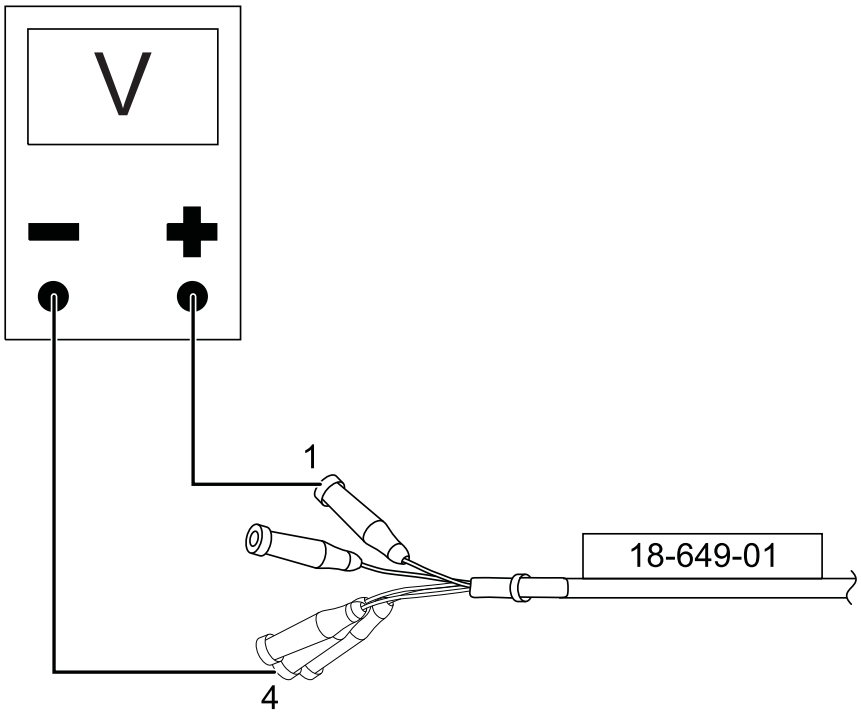


Figure 301 DOC / DPF Temperature Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 302 Test 1 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 2.

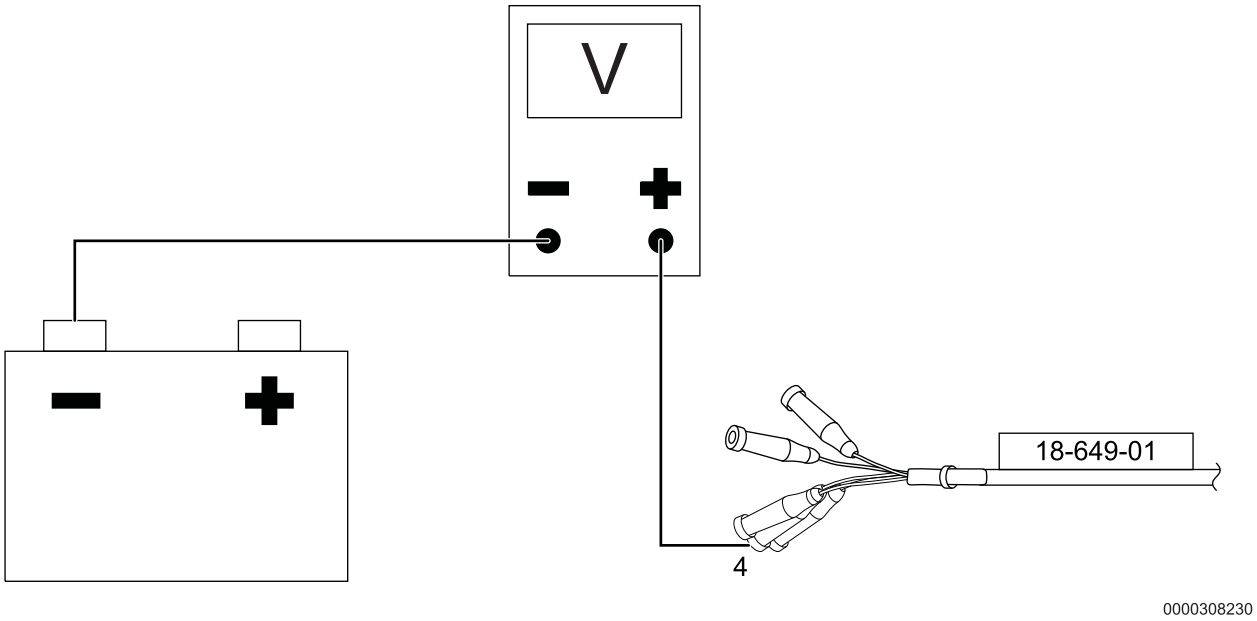


Figure 303 Test 2 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-4 and a known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair open or high resistance in ground circuit between DOC / DPF temperature sensor module connector pin-1 and ground. After repairs are complete, retest for SPN 5742 FMI 19.
	No: Repair open or short to ground in between DOC / DPF temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5742 FMI 19.

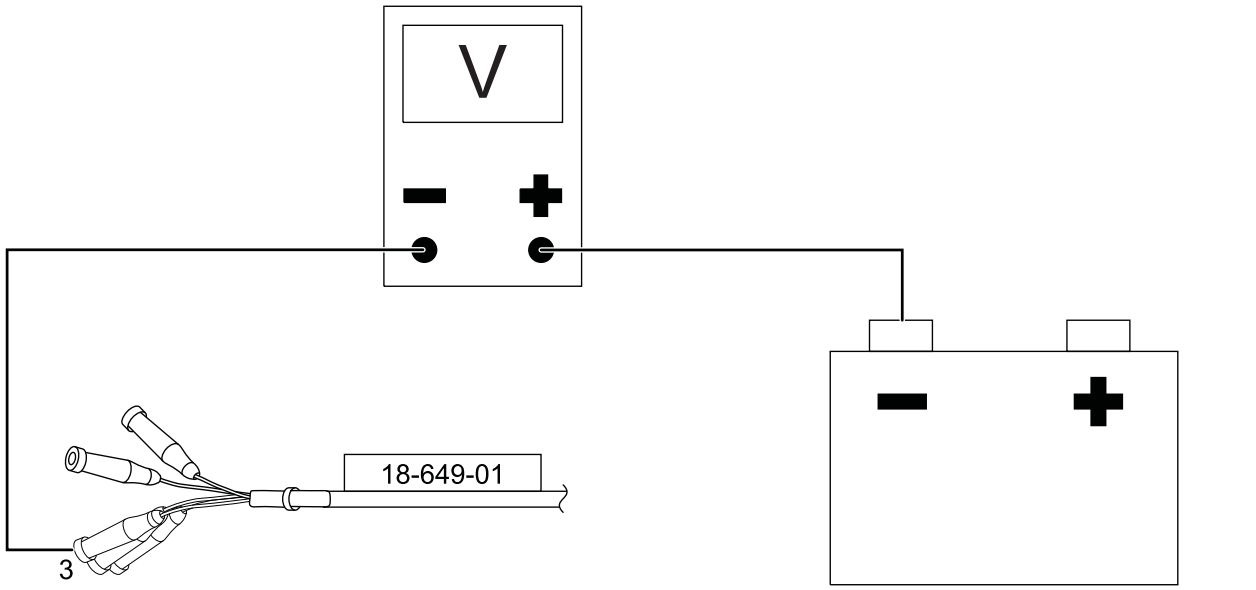


Figure 304 Test 3 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-3 and a known good GND.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 4.
	No: Repair open or short to ground in between DOC / DPF temperature sensor module connector pin-3 and Aftertreatment Control Module (ACM) connector pin J2-14. After repairs are complete, retest for SPN 5742 FMI 19.

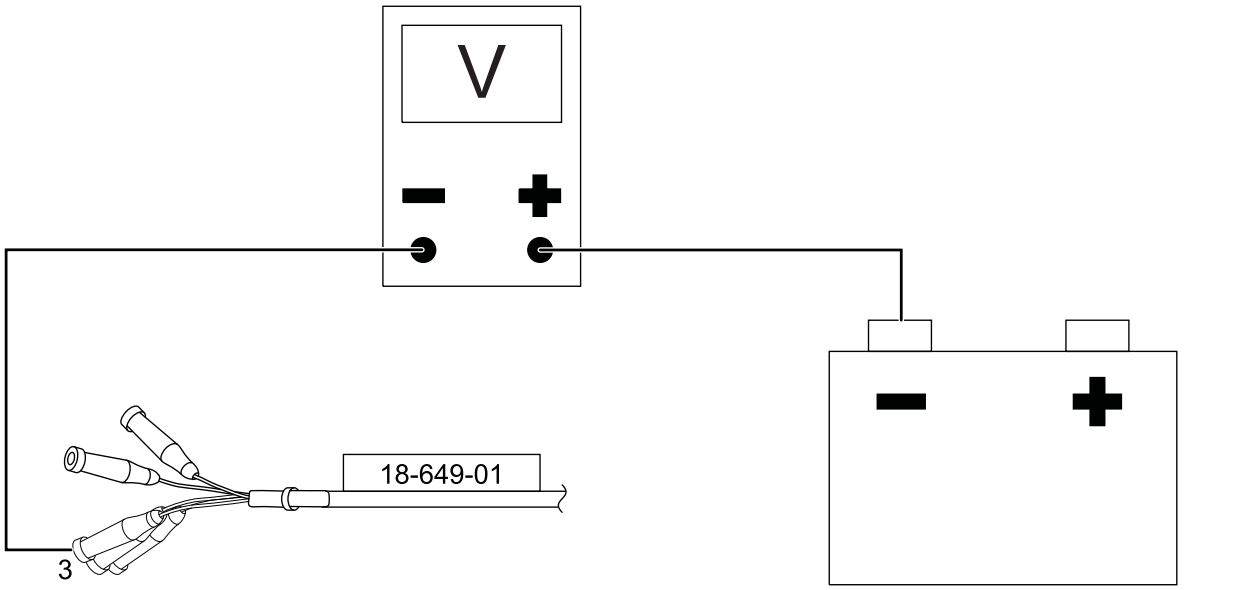


Figure 305 Test 4 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 4	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-3 and a known good GND.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 5.
	No: Repair short to power between DOC / DPF temperature sensor module connector pin-3 and Aftertreatment Control Module (ACM) connector pin J2-14. After repairs are complete, retest for SPN 5742 FMI 19.

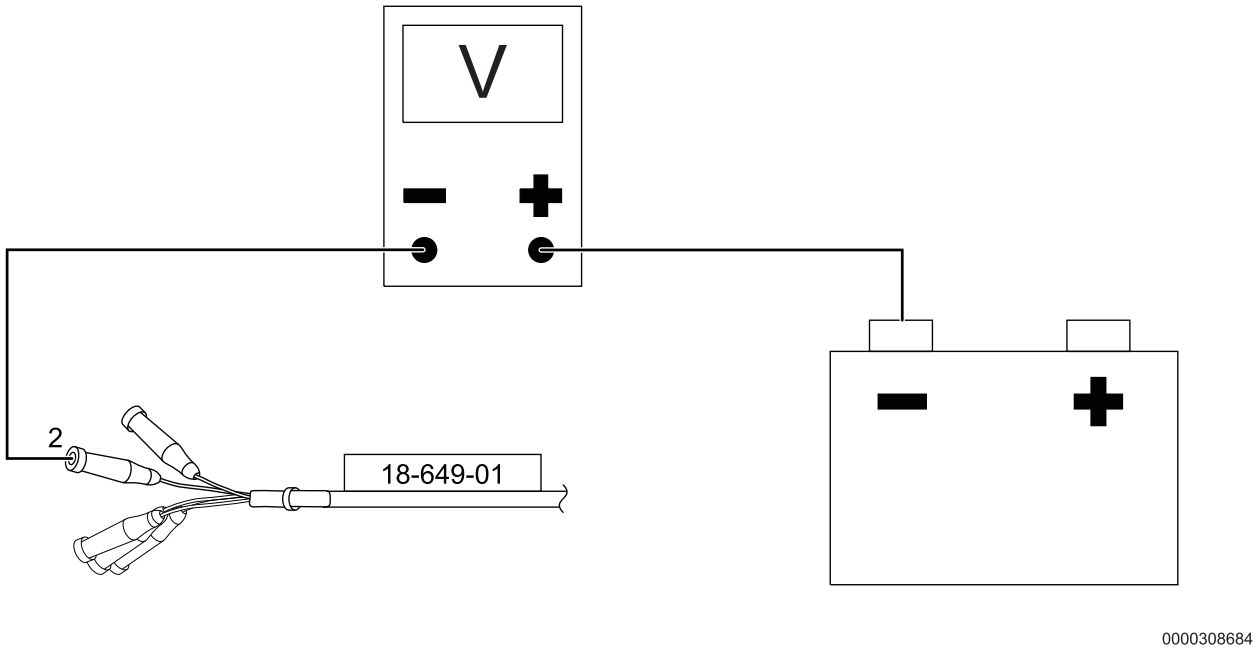


Figure 306 Test 5 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 5	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-2 and a known good GND.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 6.
	No: Repair open or short to ground between DOC / DPF temperature sensor module connector pin-2 and Aftertreatment Control Module (ACM) connector pin J2-15. After repairs are complete, retest for SPN 5742 FMI 19.

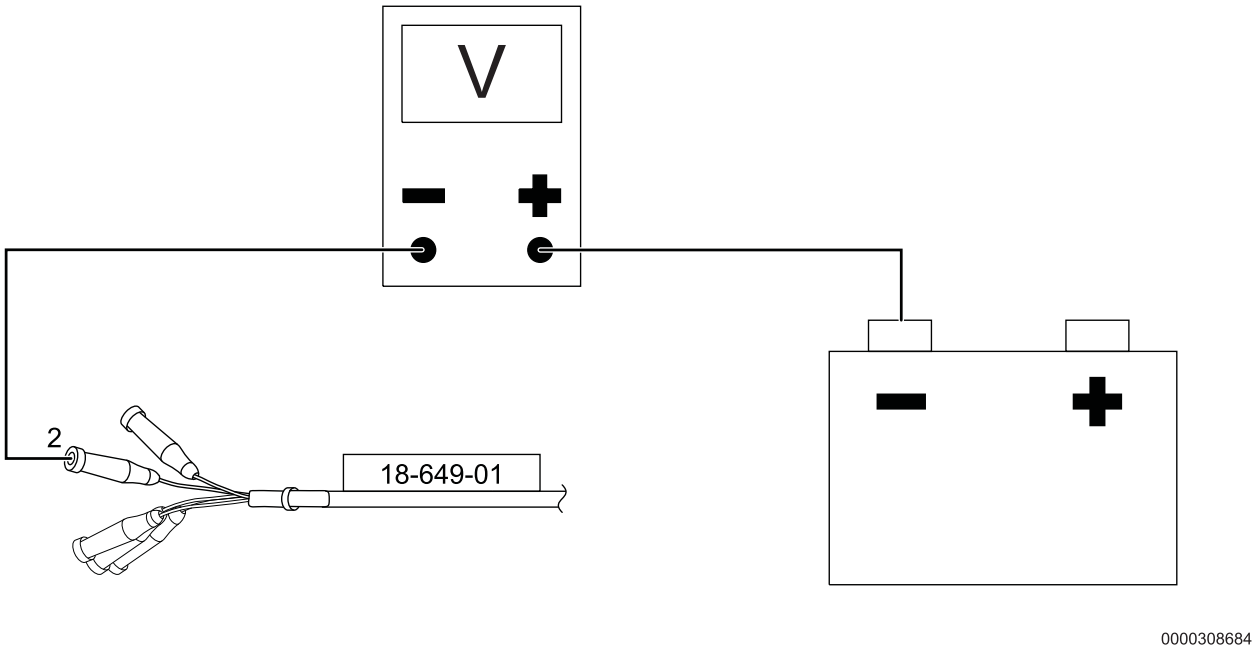
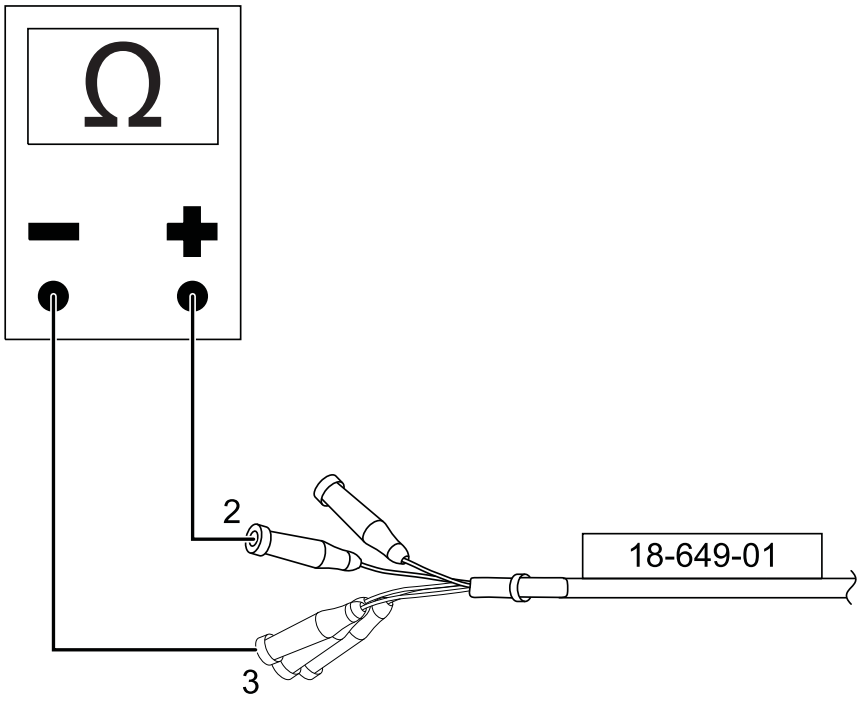


Figure 307 Test 6 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 6	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-2 and a known good GND.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 7.
	No: Repair short to power between DOC / DPF temperature sensor module connector pin-2 and Aftertreatment Control Module (ACM) connector pin J2-15. After repairs are complete, retest for SPN 5742 FMI 19.



0000308685

Figure 308 Test 7 DOC / DPF Temperature Sensor Module Circuit Voltage Check

Test 7 Setup
A. Key OFF. B. Disconnect Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module. C. Connect Breakout Harness 18-649-01 to vehicle harness and leave DOC / DPF temperature sensor disconnected. D. Key ON.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness 18-649-01 pin-2 and pin-3.	Greater than 50 ohms
Decision	
Is resistance greater than 50 ohms?	Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 5742 FMI 19.
	No: Repair short between DOC / DPF temperature sensor module connector pin-2 and pin-3. After repairs are complete, retest for SPN 5742 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5742 FMI 19 fault code diagnostics.

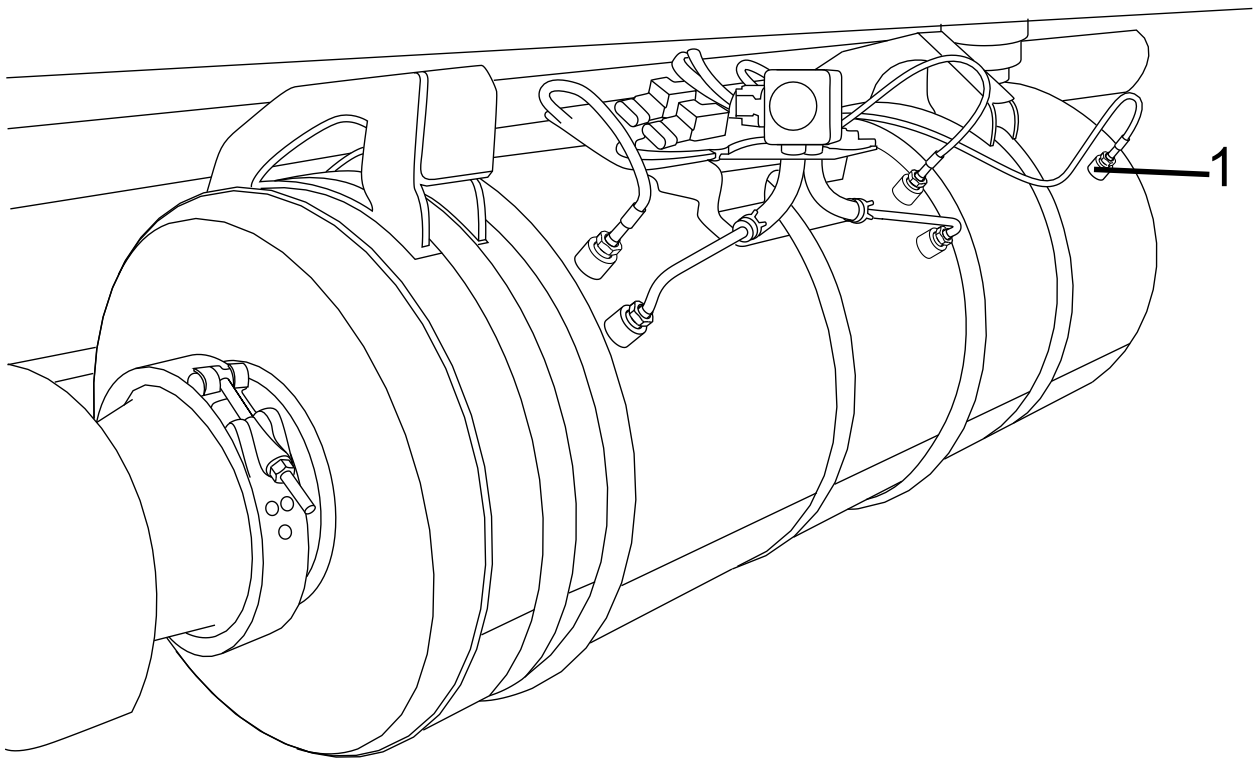
DOCIT Sensor (Diesel Oxidation Catalyst Intake Temperature)

Overview of DOCIT Sensor Group

SPN	FMI	Description
4765	2	DOCIT Signal erratic, intermittent, or incorrect (page 833)
4765	3	DOCIT signal Out of Range HIGH (page 833)
4765	4	DOCIT signal Out of Range LOW (page 835)
4765	16	DOCIT Above Maximum Temperature (page 837)

Overview

Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor measures exhaust temperature at intake of Diesel Oxidation Catalyst (DOC). Diesel Oxidation Catalyst/Diesel Particulate Filter (DOC/DPF) temperature sensor module is a smart device that communicates with Aftertreatment Control Module (ACM) via Controller Area Network (CAN). DOCIT sensor is part of DOC/DPF temperature sensor module and is not serviceable individually.



0000061526

Figure 309 DOCIT Sensor Location

SPN 4765 FMI 2 - DOCIT Signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Oxidation Catalyst Intake Temperature (DOCIT) is not changing with engine operating conditions (in-range but not rational).	Average temperature difference across Diesel Oxidation Catalyst (DOC) between -238°F (-150°C) and 149°F (65°C) OR Average Temperature difference across Diesel Particulate Filter (DPF) is not between 221F (105C) and -166F (-110C)	Key-On Engine-Running (KOER) Time since last active regeneration > 600 seconds Exhaust flow between 155 g / sec and 1,000 g / sec DOCIT, DPFIT, or DPFOT between 482°F (250°C) and 1112°F (600°C) 300 seconds have elapsed since OEM datalink requested Engine intrusive diagnostics was active

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects the difference between the Diesel Oxidation Catalyst Intake Temperature (DOCIT) and Diesel Particulate Filter Intake Temperature (DPFIT) readings do not match expected values for engine operating conditions for 300 seconds. Diesel Exhaust Fluid (DEF) injection into the aftertreatment system is disabled. Active and parked regeneration of the Diesel Particulate Filter (DPF) will be disabled. Engine torque will be reduced if the engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3242 FMI 3 and 4 (DPFIT)	• SPN 3246 FMI 3 and 4 (DPFOT)	• SPN 3480 FMI 3 and 4 (AFTFIS)	• SPN 3482 FMI 3 and 4 (AFTFEC)
• SPN 4765 FMI 3 and 4 (DOCIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 831).		Yes: Replace Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module. After repairs are complete, retest for SPN 4765 FMI 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 4765 FMI 2.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4765 FMI 2 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 4765 FMI 3 - DOCIT signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to power, or OPEN in Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor circuit.	DOCIT sensor input voltage is ≥ 5 volts or DOCIT impedance is ≥ 10 ohms	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects DOCIT sensor signal voltage is greater than expected. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled. Active and parked regeneration of Diesel Particulate Filter (DPF) will be disabled. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 833) Is EST DTC list free of SPN 5742 FMI 3, 4, 11, and 16?		Yes: Go to Step 2. No: Repair SPN 5742 FMI 3, 4, 11, and 16. After repairs are complete, retest for SPN 4765 FMI 3.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4765 FMI 3. Does EST DTC list show SPN 4765 FMI 3 as active or pending?		Yes: Replace DOC/DPF temperature sensor module. After repairs are complete, retest for SPN 4765 FMI 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4765 FMI 3 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 4765 FMI 4 - DOCIT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to ground in Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor circuit.	DOCIT sensor signal voltage is ≤ 1 volt	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor signal voltage is less than 1 volt for more than 2 seconds. Active and parked regeneration of Diesel Particulate Filter (DPF) will be disabled. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 835). Is EST DTC list free of Associated Faults?		Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 4765 FMI 4.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4765 FMI 4.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4765 FMI 4 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 4765 FMI 16 - DOCIT Above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor has exceeded maximum temperature limit (moderately severe level).	DOCIT > 1274°F (690°C) for 60 seconds.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Oxidation Catalyst Inlet Temperature (DOCIT) reading is greater than 1274°F (690°C) for 60 seconds. Active and parked regeneration will be disabled. Engine shutdown will occur 30 seconds after fault becomes active (except emergency vehicle calibrations).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 4765 FMI 2, 3, and 4 (DOCIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after DOCIT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 837). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4765 FMI 16.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4765 FMI 16. Is EST DTC list SPN 4765 FMI 16 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2 3	Check for failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 3. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4765 FMI 16.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to step 4. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4765 FMI 16.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?		Yes: Go to Step 5. No: Replace AFT: FEC. After repairs are complete, retest for SPN 4765 FMI 16.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 6. No: Replace AFT: FPC. After repairs are complete, retest for SPN 4765 FMI 16.

Step 7	Check for restricted exhaust.	Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4765 FMI 16.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 4765 FMI 16.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4765 FMI 16 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

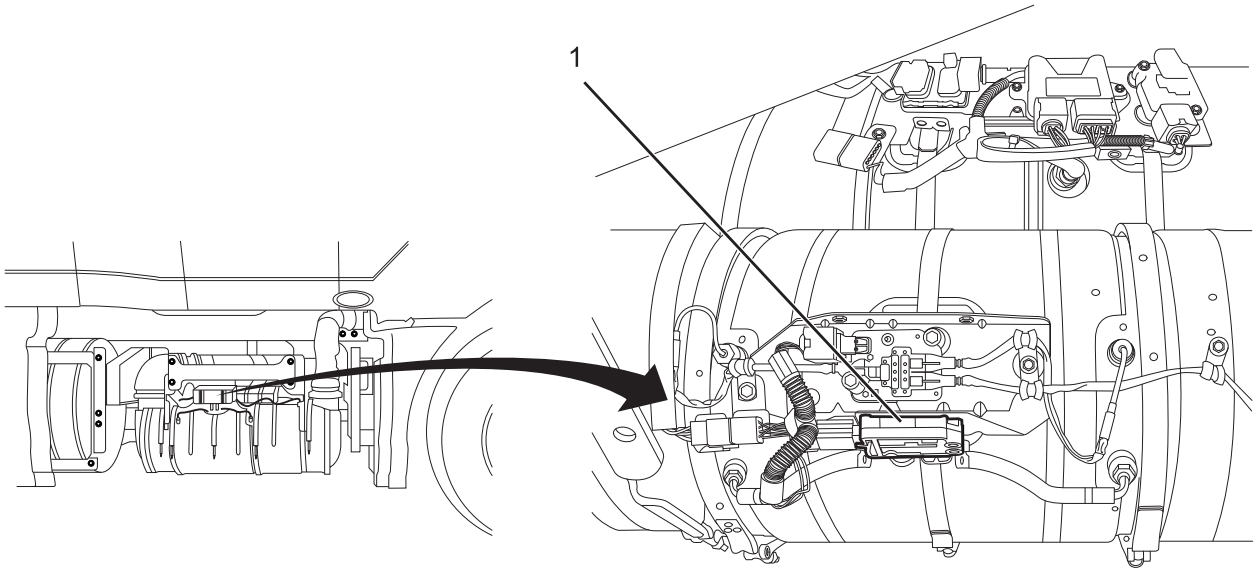
DPF (Diesel Particulate Filter) Sensor

Overview of DPF Sensor

SPN	FMI	Description
5397	31	DPF regenerations are occurring too frequently (page 841)

Overview

Diesel Particulate Filter (DPF) system is used to reduce soot released into exhaust aftertreatment system. DPF is used in conjunction with Diesel Oxidation Catalyst (DOC) to reduce soot. Process of reducing soot to ash is called regeneration (regen). Regen can be active, stationary, or passive. Passive regen needs no input from Aftertreatment Control Module (ACM) to work. Active happens when ACM commands vehicle to regen, and vehicle goes into a regen strategy. Stationary regen is used when operator manually tells ACM to begin regen process. This can be accomplished by either manually pushing an override button inside cab, or through use of Electronic Service Tool (EST) with ServiceMaxx™ software. DOC and DPF can be serviced separately.



0000058390

Figure 310 DPFDP / DPFOP Sensor Location

1. DPFDP / DPFOP sensor

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

SPN 5397 FMI 31 - DPF regenerations are occurring too frequently

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DPF system active regeneration occurring more frequently than expected.	Time between actual active regeneration events is < time between estimated active regeneration events.	Engine speed > 50 RPM Last active regeneration did not abort due to detection of malfunction with Aftertreatment system System detects DPF is no longer new Inactive: SPN 3242 FMI 0 and 15 (DPFIT); SPN 3246 FMI 0 and 15 (DPFOT); SPN 5298 FMI 17, 18 (DOC); SPN 5319 FMI 31 (DPF)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects time between completion of actual active regenerations is less than the estimated time between active regenerations.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate after this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 132 FMI 11,13,14 (MAF)	• SPN 3251 FMI 2, 3, 4 (DPFDP)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- MAF Fault
- DPFDP fault
- DPFDP hoses blocked or miss-routed
- Intake leaks/restrictions
- Exhaust restrictions

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults (page 841). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5397 FMI 31.

Step 2	Inspect connections at Diesel Particulate Filter Differential Pressure (DPFDP) sensor.	Decision
A. Key OFF B. Disconnect DPFDP sensor Check DPFDP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5397 FMI 31.

Step 3	Inspect DPFDP sensor hoses for correct routing and restrictions.	Decision
Inspect DPFDP sensor hoses, tubes and connections for kinks, improper hose routing, restrictions, or damage. Are DPFDP sensor hoses routed correctly, and not damaged, or restricted?		Yes: Go to Step 4. No: Repair leaking, restricted, or damaged hoses, and connections. After repairs are complete, retest for SPN 5397 FMI 31.

Step 4	Check intake air system for leaks or restrictions.	Decision
Inspect intake air system from air filter to engine intake manifold for restrictions, air leaks, or physical damage. Using Charge Air Cooler Test Kit ZTSE4341, pressurize CAC system to 35 psi and inspect for leaks at clamps and connections.		Yes: Go to Step 5. No: Repair restrictions, air leaks, or physical damage. After repairs are complete, retest for SPN 5397 FMI 31.

Step 5	Inspect exhaust system for restrictions, leaks or physical damage.	Decision
Perform Exhaust and Aftertreatment System Inspection (page 2368). Are exhaust system components damaged or restricted?		Yes: Repair exhaust system damage or restrictions. After repairs are complete, retest for SPN 5397 FMI 31. No: Replace DPFDP sensor. After repairs are complete, retest for SPN 5397 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5397 FMI 31 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

DPFDP / DPFOP (Diesel Particulate Filter Differential Pressure / Diesel Particulate Filter Outlet Pressure) Sensor

SPN	FMI	Description
3251	2	DPFDP signal erratic, intermittent, or incorrect (page 845)
3251	3	DPFDP signal Out of Range HIGH (page 849)
3251	4	DPFDP signal Out of Range LOW (page 854)
3610	2	DPFOP signal erratic, intermittent or incorrect (page 860)
3610	3	DPFOP signal Out of Range HIGH (page 864)
3610	4	DPFOP signal Out of Range LOW (page 870)

Overview

Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor measures pressure difference between intake and outlet of DPF, and outlet pressure of DPF. Aftertreatment regeneration will not run with DPFDP / DPFOP sensor fault codes present.

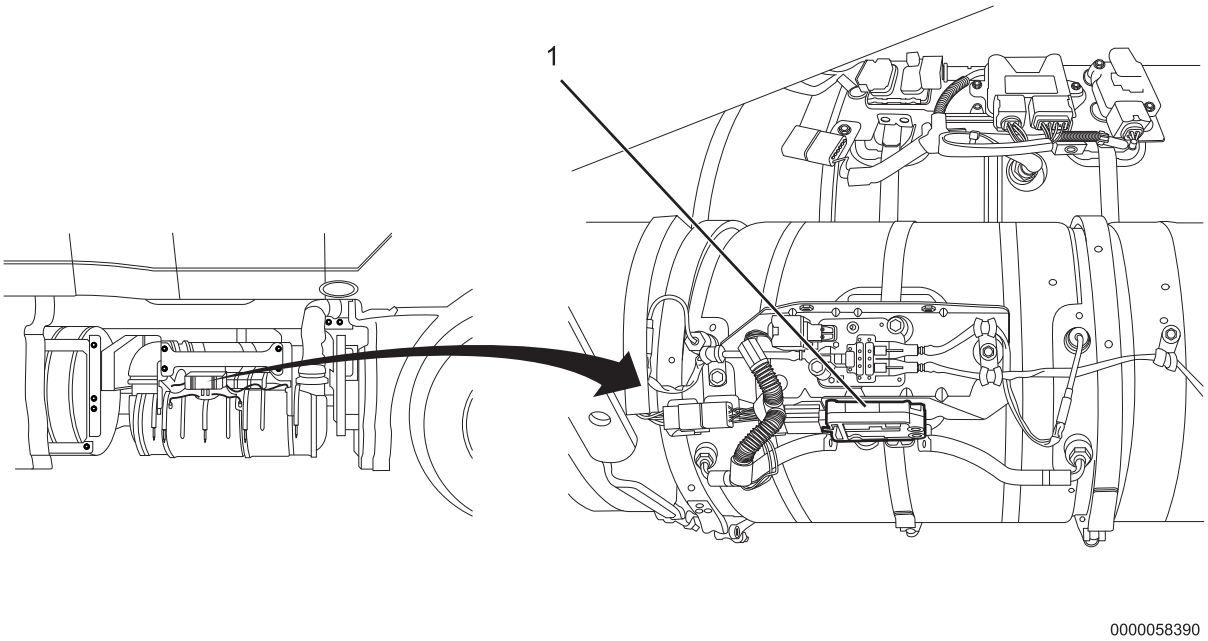


Figure 311 DPFDP / DPFOP Sensor Location

1. DPFDP / DPFOP sensor

SPN 3251 FMI 2 - DPFDP signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Differential Pressure (DPFDP) sensor key ON check indicates signal in-range but not rational or stuck in-range.	Absolute value of DPFDP > 0.25 psi (1.5 kPa) Range of DPFDP since last monitor decision when enable conditions are met < 0.15 psi (1 kpa)	Engine speed ≤ 200 RPM Elapsed time since key ON > 1 sec Range of exhaust volumetric flow since last monitor > 0.4 m3/ sec DPFDP sensor signal not saturated at high exhaust flow: (DPFDP ≤ 5.1 psi [35 kpa]) OR (Exhaust flow ≤ 1 m3/sec) Key-On Engine-Running (KOER) Inactive: SPN 3251 FMI 3, 4

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects aftertreatment Diesel Particulate Filter Differential Pressure (DPFDP) is greater than 0.25 psi (1.5 kpa), is not changing with engine conditions, or range since last monitor is less than 0.15 psi (1 kpa).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3251 FMI 3 and 4 (DPFDP)	• SPN 3512 FMI 14 (VREF 4)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DPFDP circuit high resistance
- Leaking or restricted DPFDP / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor module hoses
- Failed DPFDP / outlet pressure sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 845). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3251 FMI 2.

Step 2	Inspect hoses and tube connections at the Diesel Particulate Filter Differential Pressure (DPFDP) / DPF Outlet Pressure (DPFOP) sensor module.	Decision
Check sensor, tubes, and passages for leaks, restrictions, and damage. Are DPFDP / DPFOP sensor module connections free of leaks, restrictions, and damage?		Yes: Go to Step 3. No: Repair leaking, restricted, or damaged hoses and connections. After repairs are complete, retest for SPN 3251 FMI 2.

Step 3	Inspect connections at DPFDP / DPFOP sensor module.	Decision
A. Key OFF. B. Disconnect DPFDP / DPFOP sensor module connector. C. Check DPFDP / DPFOP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3251 FMI 2.

Step 4	Inspect connections at ACM.	Decision
A. Key OFF. B. Disconnect ACM J1 connector. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM J1 connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3251 FMI 2.

Pin-Point Tests (SPN 3251 FMI 2)

DPFDP/DPFOP Circuit

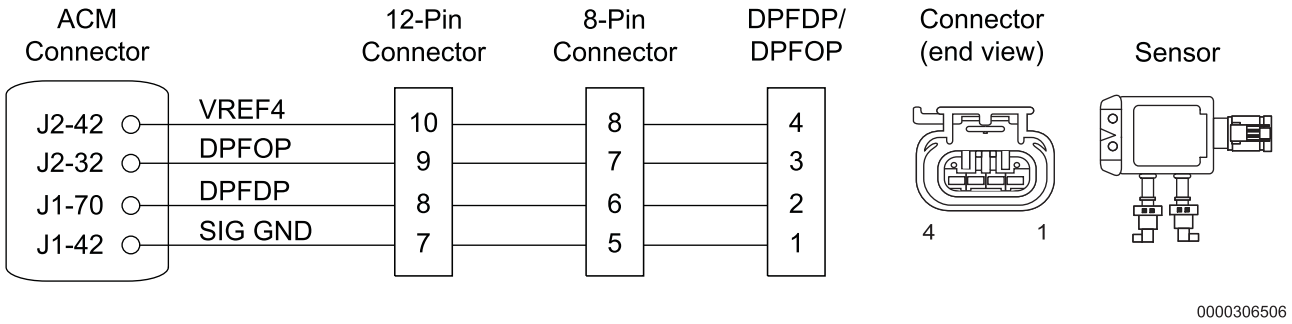


Figure 312 DPFDP / DPFOP Sensor Module Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box

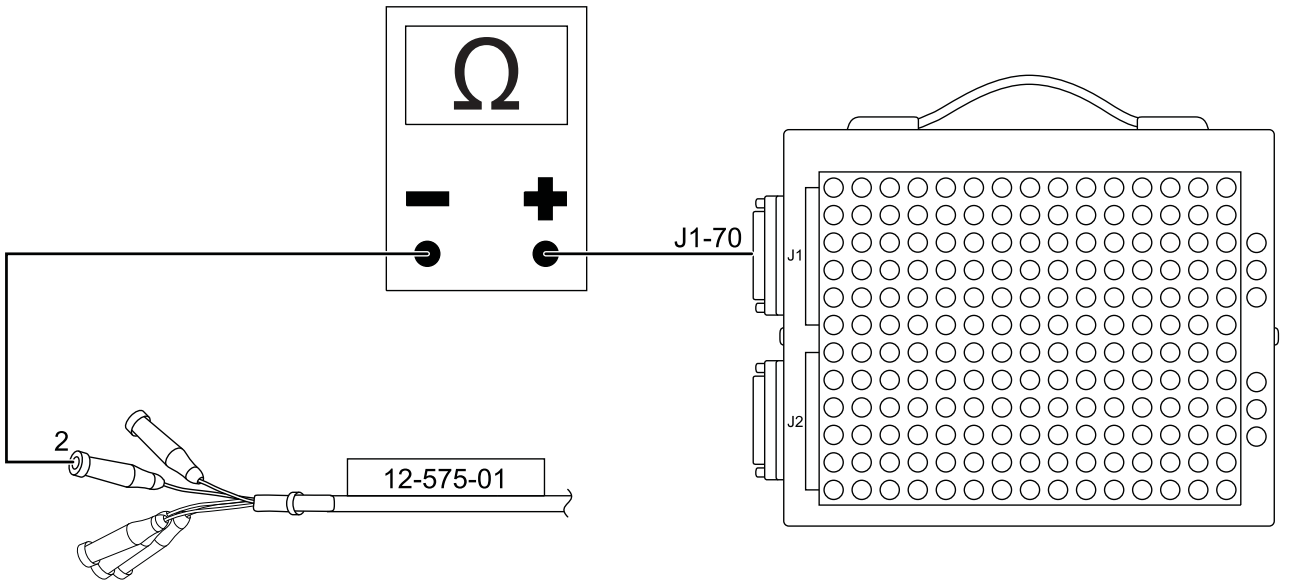


Figure 313 Test 1 DPFDP Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor module vehicle harness connector and leave sensor module disconnected. C. Connect Breakout Harness 18-537-01 (96-pin) to 180-Pin Breakout Box. D. Connect Breakout Harness 18-537-01 (96-pin) to (ACM) J1 vehicle harness connector and leave ACM disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-2 and 180-pin breakout box pin J1-70.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP / DPFOP sensor module. After repairs are complete, retest for SPN 3251 FMI 2.
	No: Repair high resistance between DPFDP / DPFOP sensor module connector pin-2 and ACM connector pin J1-70. After repairs are complete, retest for SPN 3251 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and proper decision was made. Return to SPN 3251 FMI 2 fault code diagnostics.

SPN 3251 FMI 3 - DPFDP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Differential Pressure (DPFDP) sensor reading greater than specified operating range for a specified time.	Aftertreatment DPFDP sensor value > 4.25 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Differential Pressure (DPFDP) signal voltage is greater than specification for more than 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3512 FMI 14 (VREF 4)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SIG GND circuit Open or high resistance
- DPFDP signal circuit short to PWR
- Failed DPFDP / DPF Outlet Pressure (DPFOP) sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 849). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3251 FMI 3.

Step 2	Inspect connections at DPFDP / DPF Outlet Pressure (DPFOP) sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / DPFOP sensor connector. C. Check DPFDP / DPFOP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3251 FMI 3.

Pin-Point Tests (SPN 3251 FMI 3)

DPFDP/DPFOP Circuit

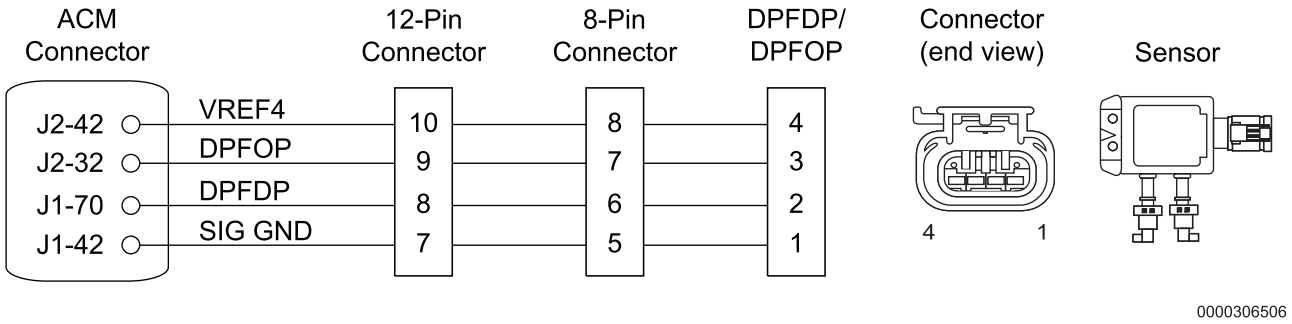


Figure 314 DPFDP / DPFOP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box 00-00956-08

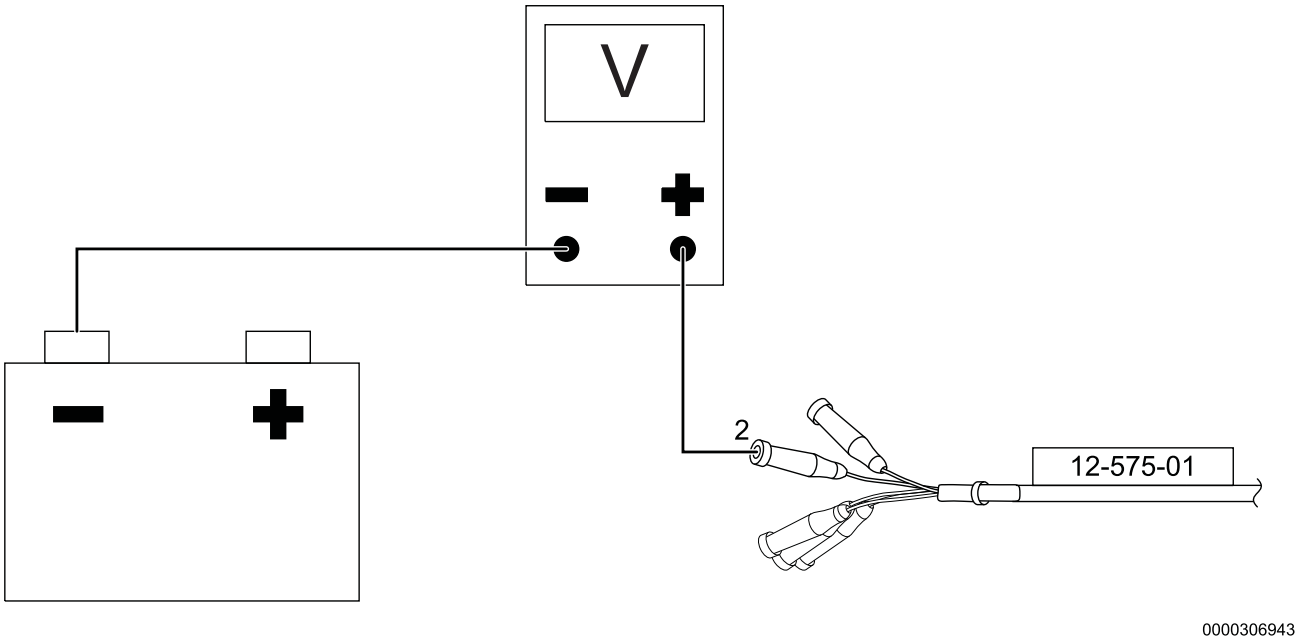


Figure 315 Test 1 DPFDP Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Diesel Particulate Filter Differential Pressure (DPFDP) / DPFOP sensor connector. C. Connect Breakout Harness 12-575-01 to vehicle harness connector and leave DPFDP / DPFOP sensor module disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 12-575-01 pin-2 and known good GND.	Less than 4.7 volts
Decision	
Is voltage less than 4.7 volts?	Yes: Perform Test 2.
	No: Repair short to power between DPFDP / DPFOP sensor connector pin-2 and ACM connector pin J1-70. After repairs are complete, retest for SPN 3251 FMI 3.

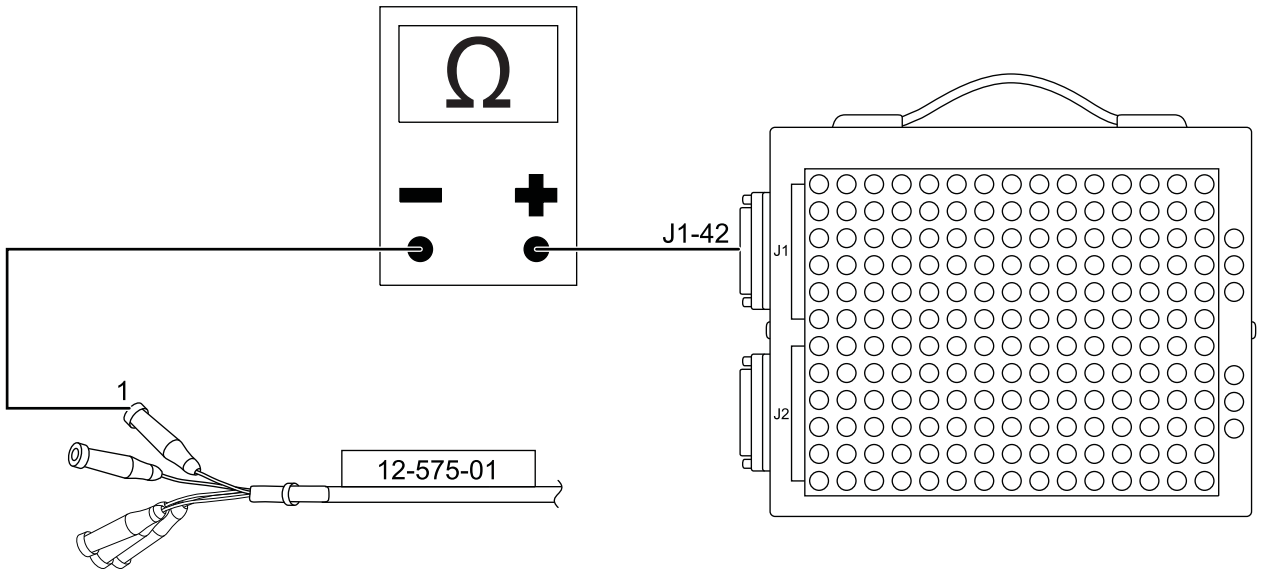


Figure 316 Test 2 SIG GND Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box 00-00956-08. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-1 and 180-pin Breakout Box 00-00956-08 pin J1-42.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP/ DPFOP sensor. After repairs are complete, retest for SPN 3251 FMI 3.
	No: Repair high resistance between the DPFDP / DPFOP sensor connector pin-1 and ACM connector pin J1-42. After repairs are complete, retest for SPN 3251 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and proper decision was made. Return to SPN 3251 FMI 3 fault code diagnostics.

SPN 3251 FMI 4 - DPFDP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Differential Pressure (DPFDP) sensor signal voltage is < than 0.25 volts for more than 2 seconds.	Aftertreatment DPFDP sensor value < 0.25 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Differential Pressure (DPFDP) signal voltage is less than specification for more than 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- VREF4 signal circuit open or high resistance
- DPFDP signal circuit short to ground
- DPFDP signal circuit open or high resistance
- Failed DPFDP / DPFOP sensor

Step 1	Inspect connections at DPFDP / DPFOP sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / DPFOP sensor connector. C. Check DPFDP / DPFOP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3251 FMI 4.

Pin-Point Tests (SPN 3251 FMI 4)

DPFDP/DPFOP Circuit

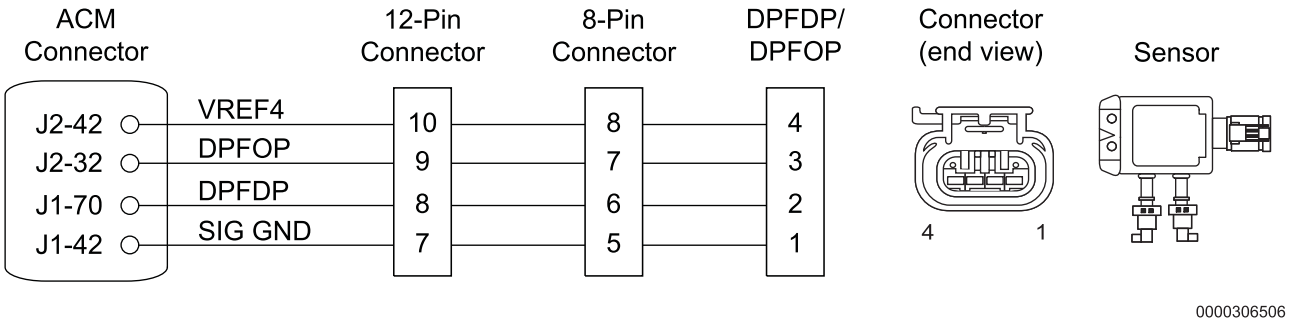


Figure 317 DPFDP / DPFOP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box 00-00956-08

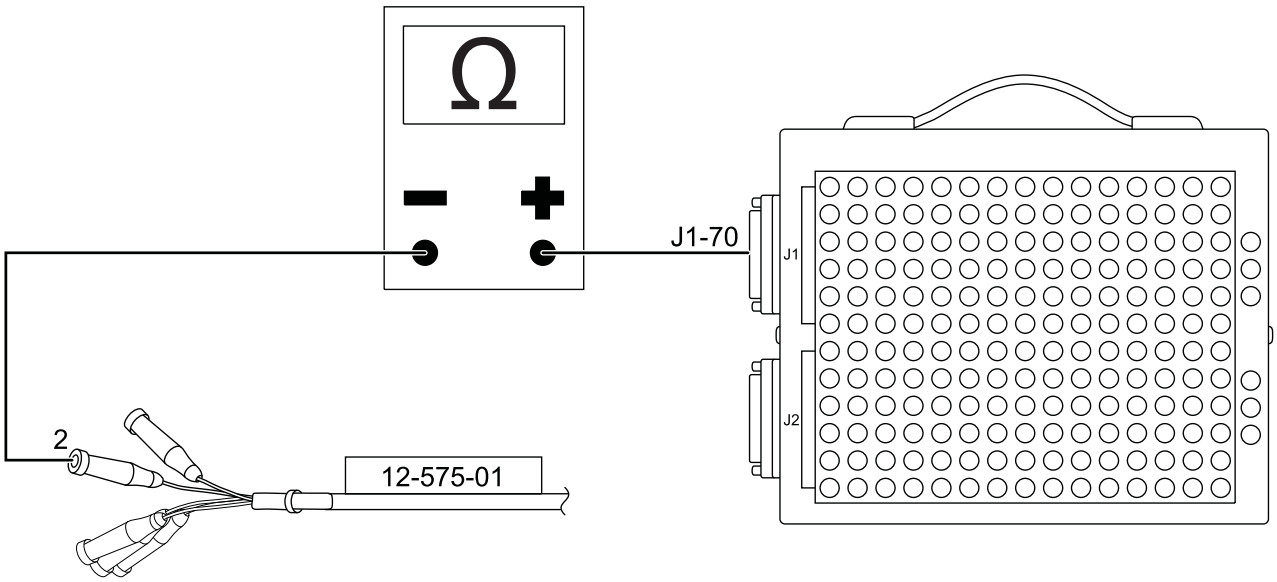


Figure 318 Test 1 DPFDP Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to ground between DPFDP / DPFOP sensor connector pin-2 and ACM connector pin J1-70. After repairs are complete, retest for SPN 3251 FMI 4.

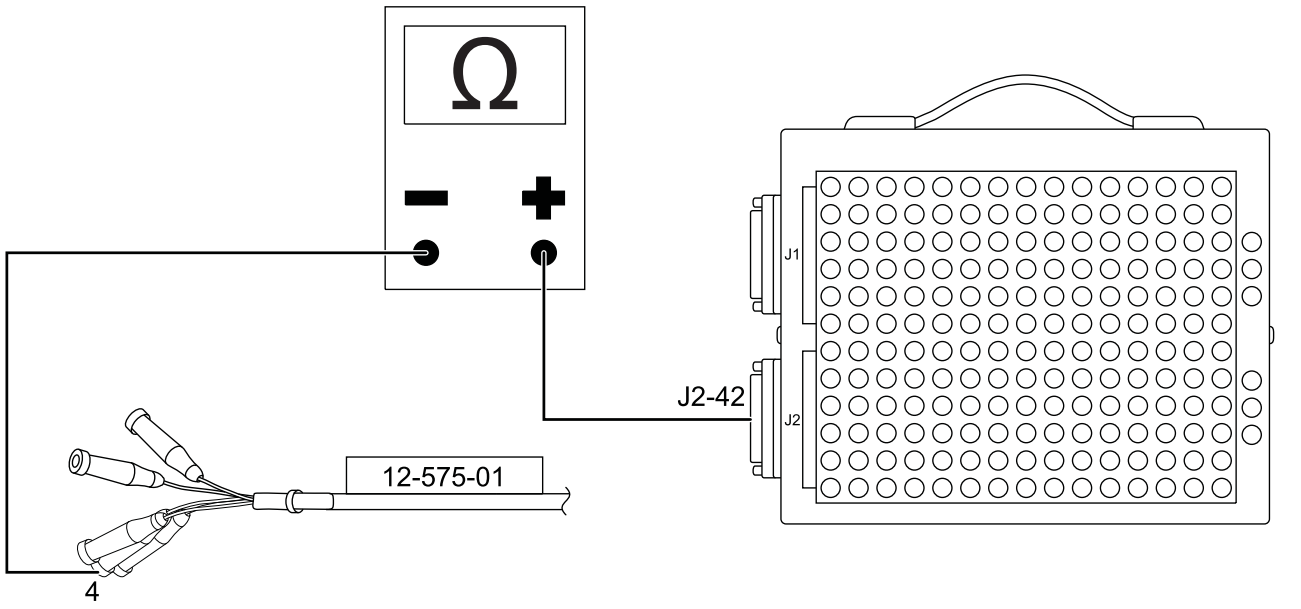


Figure 319 Test 2 DPFDP Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box 00-00956-08. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-4 and 180-pin Breakout Box pin J2-42.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3
	No: Repair open or high resistance between DPFDP / DPFOP sensor connector pin-4 and ACM connector pin J2-42. After repairs are complete, retest for SPN 3251 FMI 4.

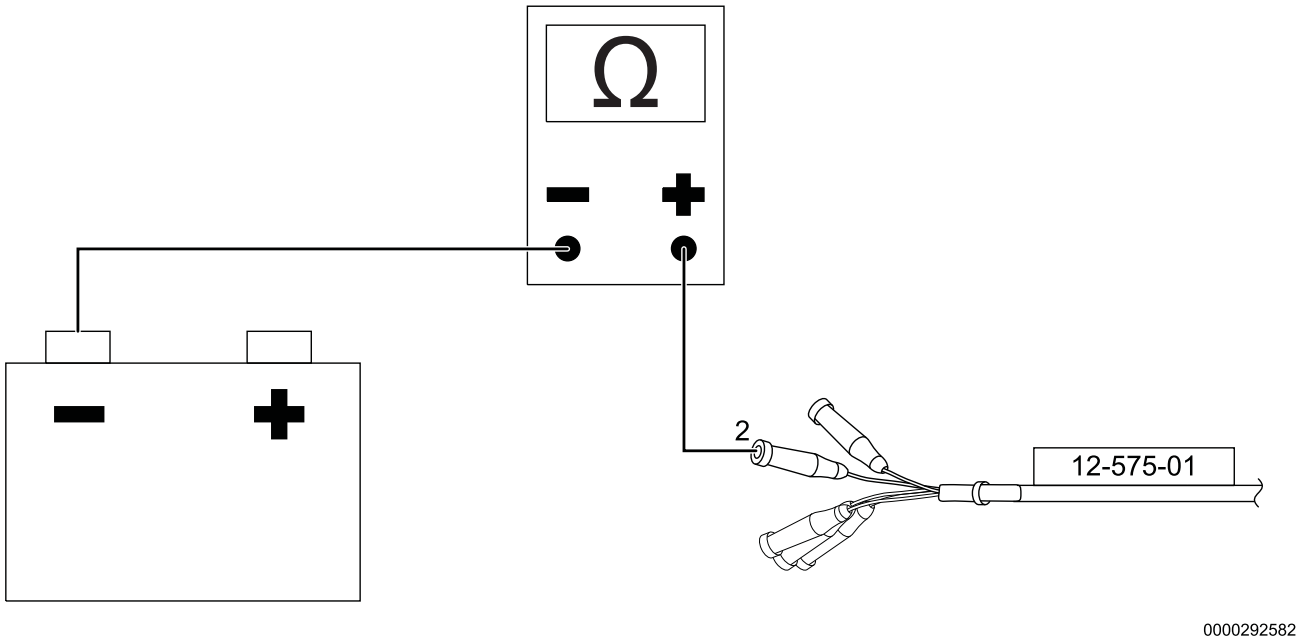


Figure 320 Test 3 DPFDP Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box 00-00956-08. D. Connect Breakout Harness 18-537-01 to ACM vehicle harness connector and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-2 and 180-pin Breakout Box 00-00956-08 pin J1-70.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP / DPFOP sensor. After repairs are complete, retest for SPN 3251 FMI 4.
	No: Repair open or high resistance between DPFDP / DPFOP sensor connector pin-2 and ACM connector pin J1-70. After repairs are complete, retest for SPN 3251 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3251 FMI 4 fault code diagnostics.

SPN 3610 FMI 2 - DPFOP Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Outlet Pressure (DPFOP) sensor stuck in-range, in-range but not rational, or in-range but reading inappropriately high.	Range of DPFOP since last monitor decision when Enable Conditions are met < 0.15 psi (1 kPa) DPFOP > 0.2 psi (1.5 kPa) or < -0.2 psi (-1.5 kPa)	Range of exhaust volumetric flow since last decision > 0.55 m3/sec DPFOP sensor signal not saturated at high exhaust flow: (DPFOP ≤ 35 kPa) or (Exhaust flow ≤ 1 m3/sec) Engine is Running Engine speed ≤ 200 RPM Elapsed time since Key ON > 1 sec. Exhaust flow > 0.4 m3/sec or Exhaust flow ≥ 0.35 m3/sec and increasing DPFOP between 0.2 psi (1.5 kPa) and -0.2 psi (-1.5 kPa) Inactive: SPN 3610 FMI 3 and 4

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Outlet Pressure (DPFOP) is greater than 0.22 psi (1.51 kPa) or less than -0.22 psi (-1.51 kPa) at initial Key ON, stuck in-range, in-range but not rational, or in-range but reading inappropriately high for 30 seconds. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3251 FMI 2, 3, and 4 (DPFDP)	• SPN 3512 FMI 3, 4, and 14 (VREF 4)	• SPN 3610 FMI 3 and 4 (DPFOP)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- DPFOP circuit high resistance
- Leaking or restricted DPFDP / DPFOP sensor hoses
- Failed DPFDP / DPFOP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 860). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3610 FMI 2.

Step 2	Inspect hoses and tube connections at Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor.	Decision
Check DPFDP / DPFOP sensor, tubes, and passages for leaks, restrictions, and damage. Are DPFDP / DPFOP sensor connections free of leaks, restrictions, and damage?		Yes: Go to Step 3. No: Repair leaking, restricted, or damaged hoses and connections. After repairs are complete, retest for SPN 3610 FMI 2.

Step 3	Inspect connections at DPFDP / DPFOP sensor.	Decision
A. Key OFF. B. Disconnect DPFDP / DPFOP sensor connector. C. Check DPFDP / DPFOP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor module connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3610 FMI 2.

Step 4	Inspect connections at ACM.	Decision
A. Key OFF. B. Disconnect ACM connector. C. Check ACM and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ACM connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests (page 862). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3610 FMI 2.

Pin-Point Tests (SPN 3610 FMI 2)

DPFDP/DPFOP Circuit

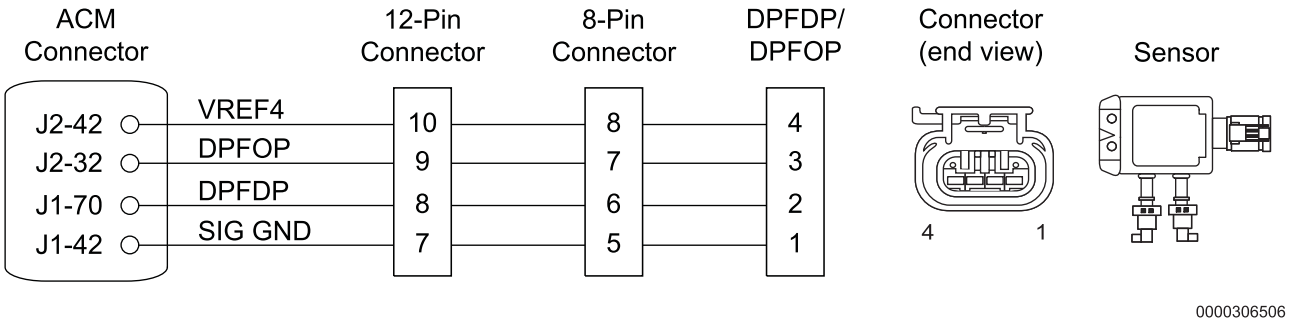
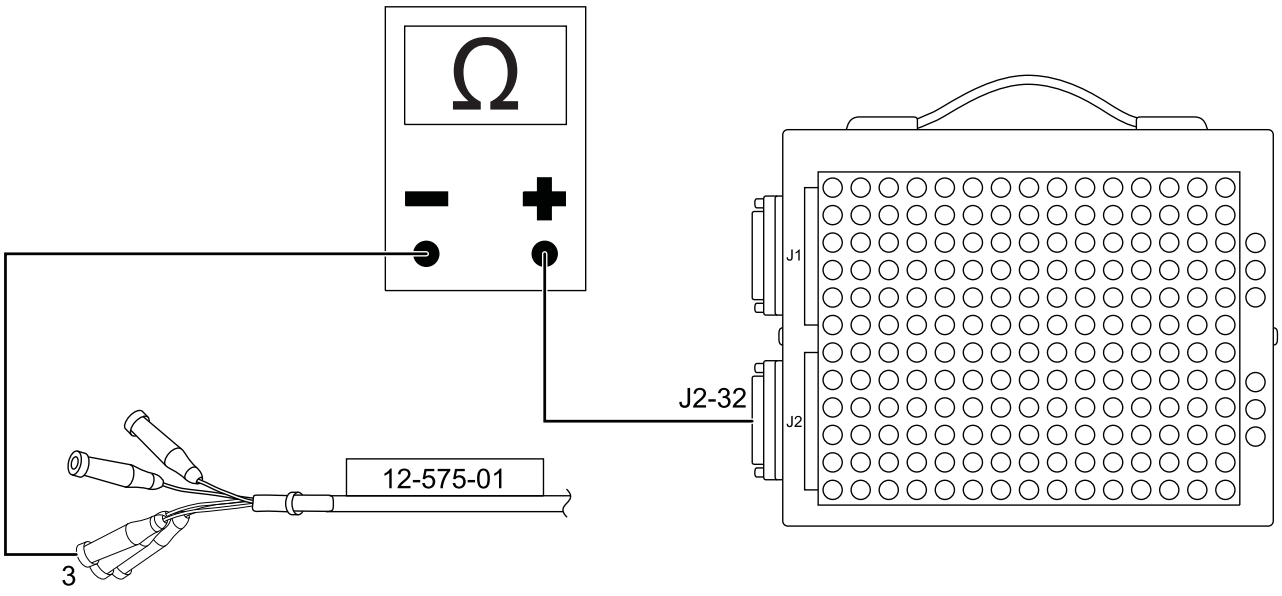


Figure 321 Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box



0000306964

Figure 322 Test 1 DPFOP Sensor Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to vehicle harness and leave Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to vehicle harness and leave Aftertreatment Control Module (ACM) disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-3 and Breakout Box pin J2-32.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP / DPFOP sensor. After repairs are complete, retest for SPN 3610 FMI 2.
	No: Repair Open or high resistance between DPFDP / DPFOP pin-3 and ACM pin J2-32. After repairs are complete, retest for SPN 3610 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3610 FMI 2 fault code diagnostics.

SPN 3610 FMI 3 - DPFOP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Outlet Pressure (DPFOP) sensor reading is greater than specified operating range for a specified time, or shorted to high source.	Aftertreatment DPFOP sensor value > 4.75 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Outlet Pressure (DPFOP) signal voltage is greater than specification for more than 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3512 FMI 3, 4 and 14 (VREF 4)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SIG GND circuit Open or high resistance
- DPFOP signal circuit short to PWR
- Failed DPF Differential Pressure (DPFDP) / DPFOP sensor module

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 864). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3610 FMI 3.

Step 2	Inspect connections at Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor module.	Decision
A. Key OFF. B. Disconnect DPFDP / DPFOP sensor module connector. C. Check DPFDP / DPFOP sensor module and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor module connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3610 FMI 3.

Pin-Point Tests (SPN 3610 FMI 3)

DPFDP/DPFOP Circuit

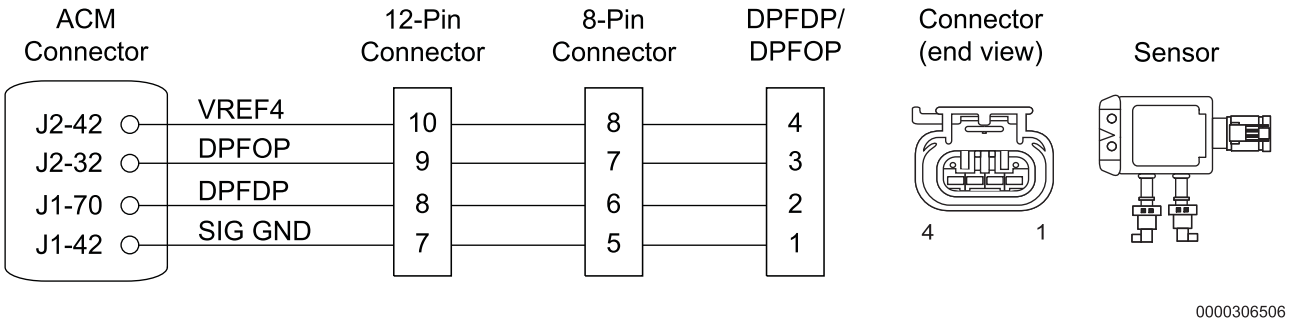


Figure 323 DPFOP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box 00-00956-08

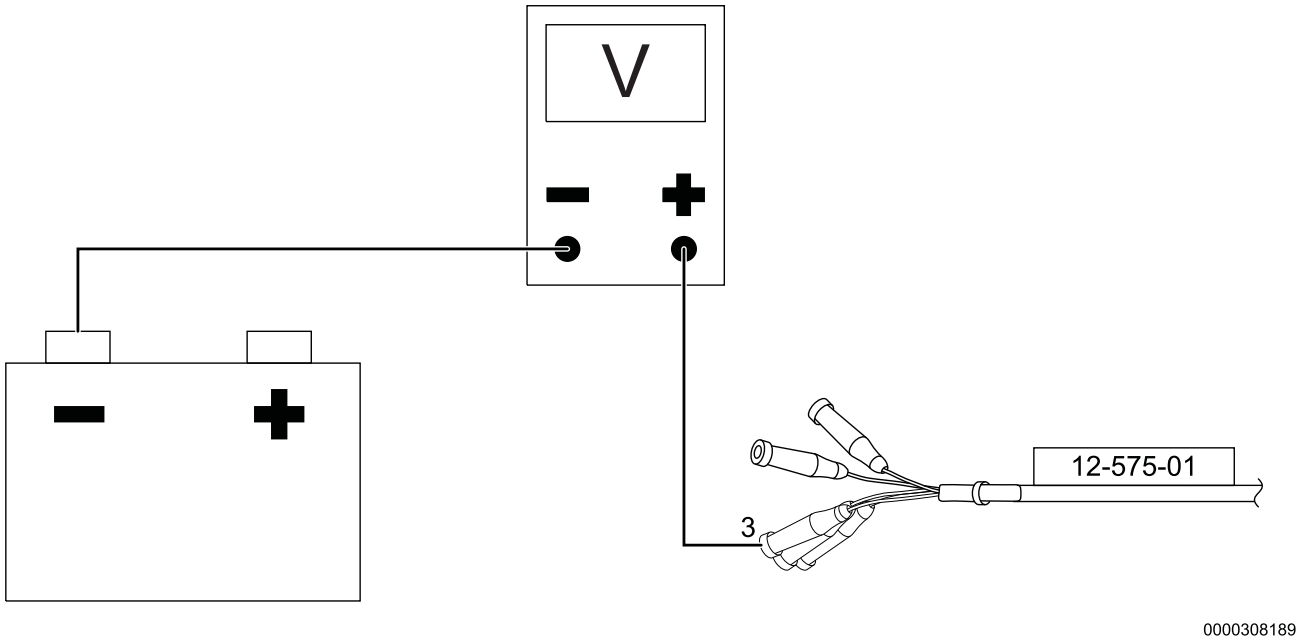


Figure 324 Test 1 DPFOP Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to Diesel Particulate Filter Differential Pressure (DPFDP) / Diesel Particulate Filter Outlet Pressure (DPFOP) sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 12-575-01 pin-3 and known good GND.	Less than 4.7 volts
Decision	
Is voltage less than 4.7 volts?	Yes: Go to Test 2.
	No: Repair short to PWR between DPFDP / DPFOP sensor module connector pin-3 and Aftertreatment Control Module (ACM) connector pin J2-32. After repairs are complete, retest for SPN 3610 FMI 3.

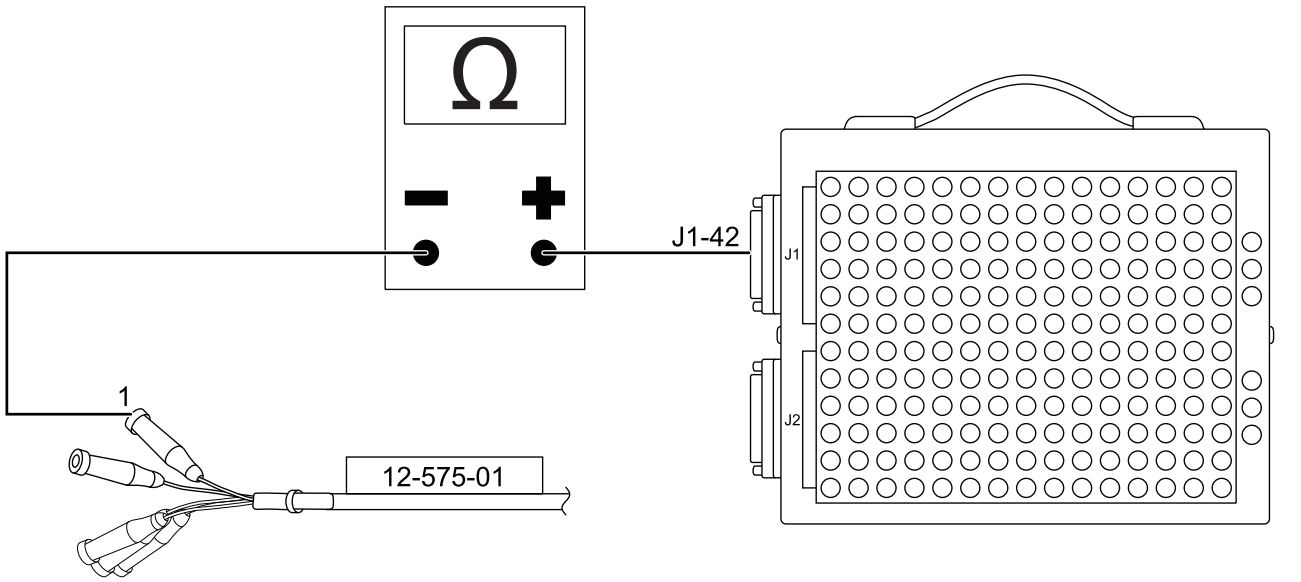


Figure 325 Test 2 DPFDP / DPFOP Sensor Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor module vehicle harness connector and leave sensor module disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to Aftertreatment Control Module (ACM) connector and leave ACM disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-1 and 180-pin Breakout Box pin J1-42.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP / DPFOP sensor module. After repairs are complete, retest for SPN 3610 FMI 3.
	No: Repair Open or high resistance between DPFDP / DPFOP sensor module connector pin-1 and ACM connector pin J1-42. After repairs are complete, retest for SPN 3610 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3610 FMI 3 fault code diagnostics.

SPN 3610 FMI 4 - DPFOP Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Outlet Pressure (DPFOP) sensor reading is less than specified operating range for a specified time.	Aftertreatment DPFOP sensor value < 0.25 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects aftertreatment Diesel Particulate Filter Outlet Pressure (DPFOP) signal voltage is greater than specification for more than 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3512 FMI 3 and 4 (VREF 4)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- VREF4 circuit Open or high resistance
- DPFOP circuit short to GND
- DPFOP circuit Open or high resistance
- Failed DPFDP / DPFOP sensor

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 870). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3610 FMI 4.

Step 2	Inspect connections at DPFDP / DPFOP sensor.	Decision
A. Key OFF. B. Disconnect Diesel Particulate Filter Differential Pressure / Diesel Particulate Filter Outlet Pressure (DPFDP / DPFOP) sensor connector. C. Check DPFDP / DPFOP sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / DPFOP sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3610 FMI 4.

Pin-Point Tests (SPN 3610 FMI 4)

DPFDP/DPFOP Circuit

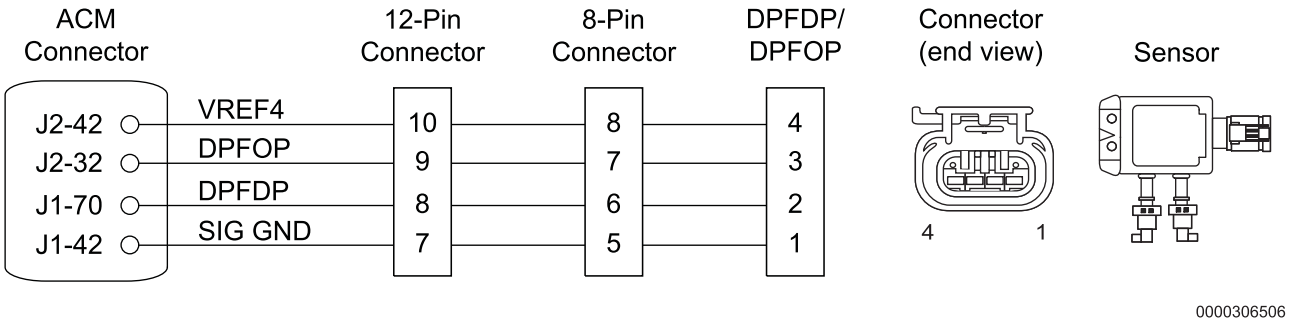


Figure 326 DPFOP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 12-575-01
- Breakout Harness 18-537-01
- Digital Multimeter (DMM)
- 180-pin Breakout Box 00-00956-08

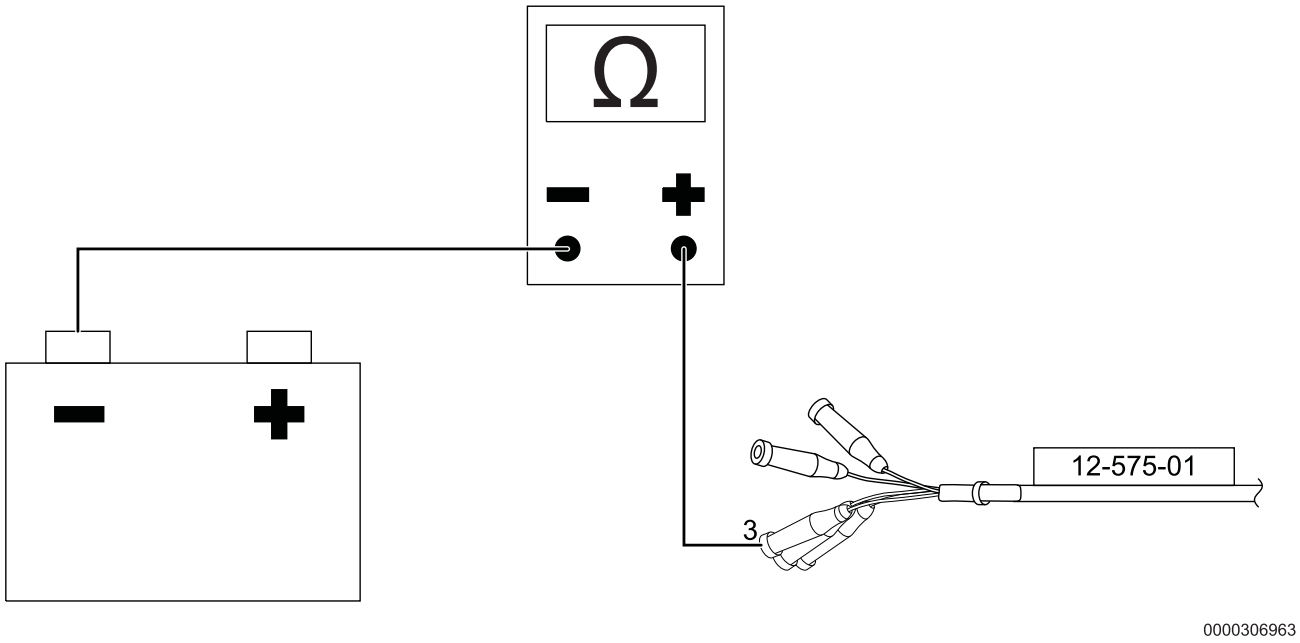


Figure 327 Test 1 DPFOP Sensor Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to GND between DPFDP / DPFOP sensor connector pin-3 and ACM connector pin J2-32. After repairs are complete retest for SPN 3610 FMI 4.

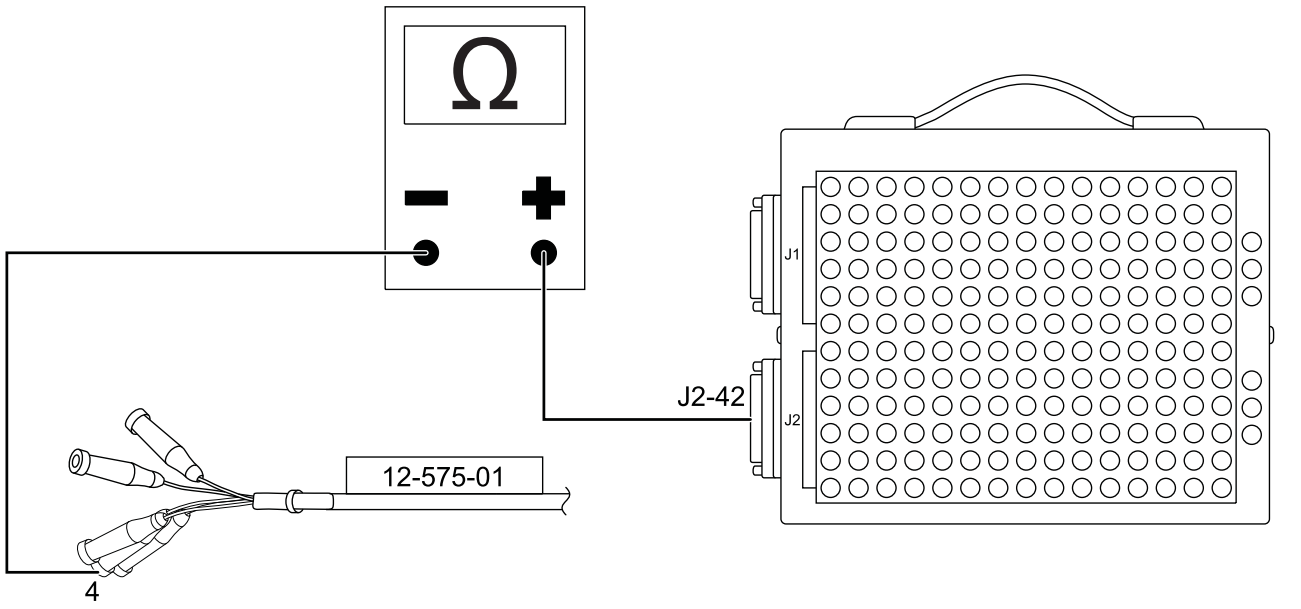
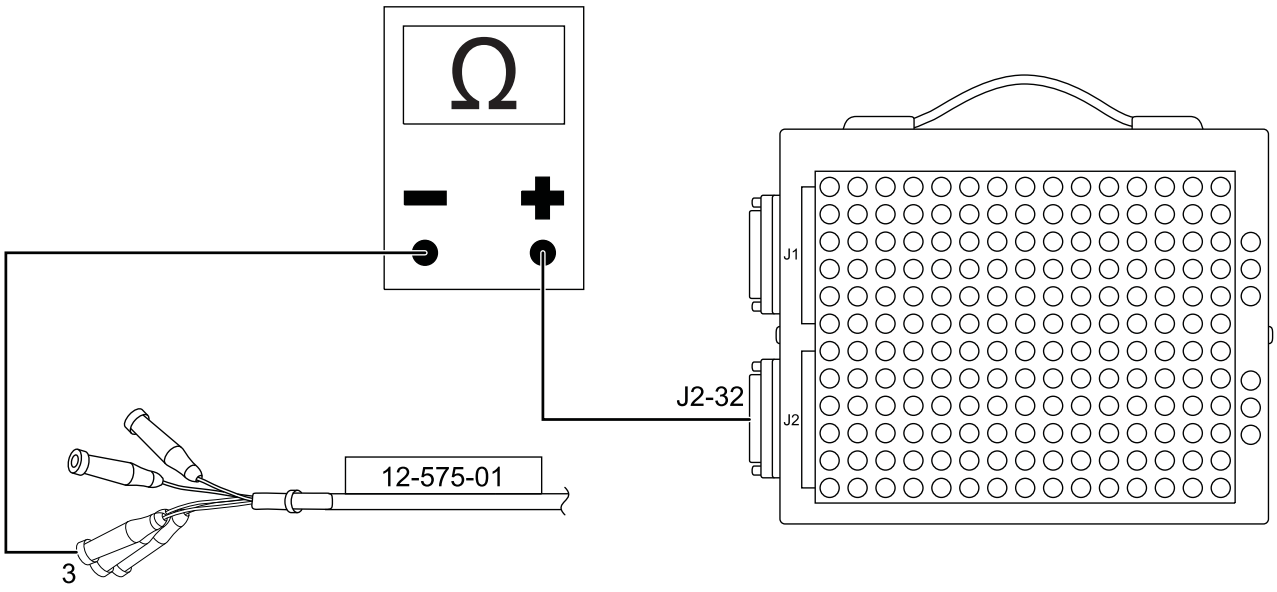


Figure 328 Test 2 DPFOP Sensor Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to ACM connector and leave ACM disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-4 and 180-pin Breakout Box pin J2-42.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 3.
	No: Repair Open or high resistance between DPFDP / DPFOP sensor connector pin-4 and ACM connector pin J2-42. After repairs are complete, retest for SPN 3610 FMI 4.



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Figure 329 Test 3 DPFOP Sensor Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 12-575-01 to DPFDP / DPFOP sensor vehicle harness connector and leave sensor disconnected. C. Connect Breakout Harness 18-537-01 to 180-pin Breakout Box. D. Connect Breakout Harness 18-537-01 to ACM connector and leave ACM disconnected.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness 12-575-01 pin-3 and 180-pin Breakout Box pin J2-32.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace DPFDP / DPFOP sensor. After repairs are complete, retest for SPN 3610 FMI 4.
	No: Repair Open or high resistance between DPFDP / DPFOP sensor connector pin-3 and ACM connector pin J2-32. After repairs are complete, retest for SPN 3610 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3610 FMI 4 fault code diagnostics.

DPFIT Sensor (Diesel Particulate Filter Intake Temperature)

Overview of DPFIT Sensor Group

SPN	FMI	Condition
3242	0	DPFIT above Critical Temperature (page 877)
3242	2	DPFIT signal erratic, intermittent, or incorrect (page 880)
3242	3	DPFIT signal Out of Range HIGH (page 882)
3242	4	DPFIT signal Out of Range LOW (page 884)
3242	15	DPFIT above Warning Temperature (page 886)
3242	16	DPFIT above Maximum Temperature (page 889)
4766	15	DPFIT Above Warning Temperature (page 892)
4766	16	DPFIT Above Maximum Temperature (page 895)

Overview

Diesel Particulate Filter Intake Temperature (DPFIT) sensor measures exhaust temperature at intake of the DPF. DOC / DPF temperature sensor module is a smart device that communicates with Aftertreatment Control Module (ACM) via Controller Area Network (CAN). DPFIT sensor is part of the DOC / DPF temperature sensor module and is not serviceable individually.

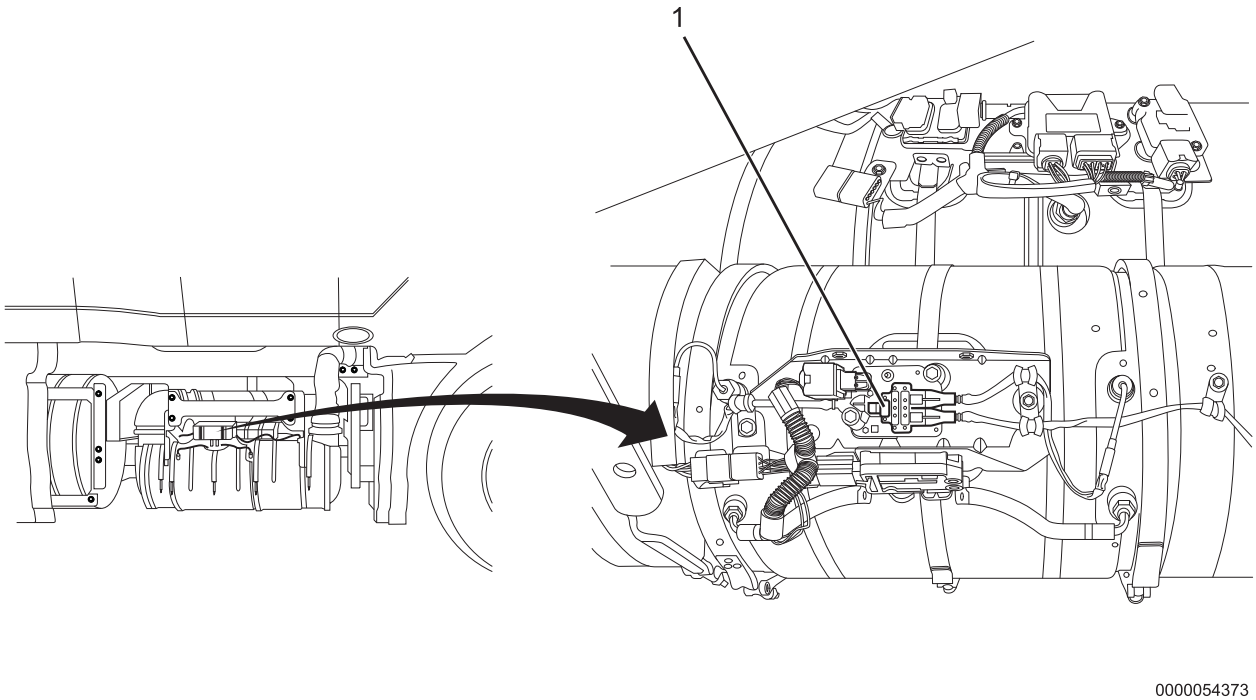


Figure 330 DOC / DPF Temperature Sensor Module Location

1. DOC / DPF Temperature Sensor Module

SPN 3242 FMI 0 - DPFIT above Critical Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Intake Temperature (DPFIT) above Critical	DPFIT is continuously above 1472°F (800°C) for a predetermined amount of time OR DPFIT - Diesel Oxidation Catalyst Intake Temperature (DOCIT) > 1004°F (540°C)	Key ON

Fault Overview

Fault is set when Diesel Particulate Filter Intake Temperature (DPFIT) is above Critical. DPFIT is continuously above 1472°F (800°C) for a predetermined amount of time; or DPFIT - Diesel Oxidation Catalyst Intake Temperature (DOCIT) > 1004°F (540°C).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL Balance)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF temp sensor module)	

Fault Facts

This fault will go inactive after DPFIT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Road test.

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Shutoff Valve
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 877). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 0.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3242 FMI 0. Is EST DTC list SPN 3242 FMI 0 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check accuracy of aftertreatment temperature sensors.	Decision
Perform Hot Run Sensor Comparison Test(page 2103). Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures. Is DOCIT, DPFIT, and DPFOT temperatures within 77°F (25°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 0.

Step 4	Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine.	Decision
Remove exhaust plumbing from turbocharger outlet. Was the turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3242 FMI 0.

Step 5	Check for leak in Down Stream Injection (DSI)system	Decision
Perform KOER DSI System Test(page 2187). Does test complete successfully?		Yes: Go to Step 6. No: Repair fault indicated by system test. After repairs are complete, retest for SPN 3242 FMI 0.

Step 6	Inspect Diesel Oxidation Catalyst (DOC) for restrictions.	Decision
A. Remove DOC. B. Inspect DOC. C. Check DOC face of the for soot accumulation, face plugging, or damage. Are 50 percent or more of cells on intake face completely blocked by soot?		Yes: Clean or replace DOC. After repairs are complete, retest for SPN 3242 FMI 0. No: Reinstall DOC and perform Parked Regeneration. After repairs are complete, retest for SPN 3242 FMI 0.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3242 FMI 0 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3242 FMI 2 - DPFIT signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Intake Temperature (DPFIT) is Not changing with engine operating conditions (in-range but not rational).	Average temperature drop across Diesel Oxidation Catalyst (DOC) > 149°F (65°C) or < -238°F (-150°C) Average temperature drop across Diesel Particulate Filter (DPF) > 221°F (105°C) or < -166°F (-110°C)	Key-On Engine-Running (KOER) Time since last active regeneration > 600 seconds Exhaust flow between 115 g/sec and 1,000 g/sec DOCIT, DPFIT, or DPFOT between 482°F (250°C) and 1112°F (600°C)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that difference between Diesel Particulate Filter Intake Temperature (DPFIT) sensor and Diesel Particulate Filter Outlet Temperature (DPFOT) OR Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor readings do not match expected values for engine operating conditions within 500 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3242 FMI 3 and 4 (DPFIT)	• SPN 3246 FMI 3 and 4 (DPFOT)	• SPN 3480 FMI 3 and 4 (AFTFP1)	• SPN 3482 FMI 3, 4, and 7 (AFT: FSV)
• SPN 4765 FMI 3 and 4 (DOCIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF Temperature Sensor Module)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 880).		Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 2.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3242 FMI 2 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3242 FMI 3 - DPFIT signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to power or Open in Diesel Particulate Filter Intake Temperature (DPFIT) sensor circuit.	DPFIT sensor input voltage is ≥ 5 volts, or impedance is ≥ 10 ohms OR DPFIT impedance ≥ 10 Ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that DPFIT sensor signal voltage is greater than expected for 16 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF temperature sensor module)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 882). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 3.

Step 2	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 3242 FMI 3. Does EST DTC list show SPN 3242 FMI 3 as active or pending?		Yes: Replace Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing diagnostic steps, if SPN 3242 FMI 3 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3242 FMI 4 - DPFIT signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to ground in Diesel Particulate Filter Intake Temperature (DPFIT) sensor circuit.	DPFIT sensor input voltage is ≤ 1 volt.	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that DPFIT sensor signal voltage is less than 1 volt for more than 2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF temperature sensor module)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 884). Is EST DTC list free of Associated Faults?		Yes: Replace Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 4.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 4.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3242 FMI 4 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3242 FMI 15 - DPFIT above Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Intake Temperature (DPFIT) sensor above Warning Temperature	TBD	Key ON

Fault Overview

Fault is set when Engine Control Module (ECM) detects Diesel Particulate Filter Intake Temperature (DPFIT) sensor is above Warning Temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Intake Temperature (DPFIT) drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 886). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 15.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3242 FMI 15. Is EST DTC list SPN 3242 FMI 15 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 15.

Step 4		Decision
Inspect turbocharger exhaust outlet for oil or fuel in the aftertreatment system from the engine. Remove exhaust plumbing from the turbocharger outlet. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3242 FMI 15.

Step 5		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is the AFT Fuel Injector (AFTFI) dry and free of fuel?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3242 FMI 15.

Step 6		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3242 FMI 15.

Step 7		Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform KOER Aftertreatment DPF Regeneration Procedure. After repairs are complete, retest for SPN 3242 FMI 15.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 3242 FMI 15.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3242 FMI 15 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3242 FMI 16 - DPFIT above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Intake Temperature (DPFIT) above Maximum Temperature	TBD	Key ON

Fault Overview

Fault is set when Engine Control Module (ECM) detects Diesel Particulate Filter Intake Temperature (DPFIT) sensor is above Maximum Temperature.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Intake Temperature (DPFIT) sensor drops below maximum limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 889). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3242 FMI 16.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3242 FMI 16. Is EST DTC list SPN 3242 FMI 16 Active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3242 FMI 16.

Step 4		Decision
Inspect turbocharger exhaust outlet for oil or fuel in the aftertreatment system from the engine. Remove exhaust plumbing from the turbocharger outlet. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3242 FMI 16.

Step 5		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is the AFT Fuel Injector (AFTFI) dry and free of fuel?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3242 FMI 16.

Step 6		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3242 FMI 16.

Step 7		Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform KOER Aftertreatment DPF Regeneration Procedure. After repairs are complete, retest for SPN 3242 FMI 16.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 3242 FMI 16.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3242 FMI 16 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 4766 FMI 15 - DPFIT Above Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
The Diesel Particulate Filter Inlet Temperature (DPFIT) sensor reading has exceeded the maximum temperature (least severe level).	DPFIT > 1247°F (675°C) for 5 seconds on five separate occasions	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Inlet Temperature (DPFIT) reading is greater than 1247°F (675°C) for 5 seconds on five separate occasions. Active and parked regeneration will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL Balance)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after DPFIT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 892). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4766 FMI 15.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4766 FMI 15. Is EST DTC list SPN 4766 FMI 15 Active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check for failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4766 FMI 15.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4766 FMI 15.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 4766 FMI 15.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FPC. After repairs are complete, retest for SPN 4766 FMI 15.

Step 7	Check for restricted exhaust.	Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4766 FMI 15.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 4766 FMI 15.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4766 FMI 15 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4766 FMI 16 - DPFIT Above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Inlet Temperature (DPFIT) sensor reading has exceeded maximum temperature (moderately severe level).	DPFIT > 1202°F (650°C) for 85 seconds OR Difference between Diesel Oxidation Catalyst Inlet Temperature (DOCIT) and Diesel Particulate Filter Inlet Temperature (DPFIT) is greater than (689°F) (365°C) for 50 seconds.	Key ON

Fault Overview

Fault code sets when the Aftertreatment Control Module (ACM) detects the Diesel Particulate Filter Inlet Temperature (DPFIT) reading is greater than 1269°F (687°C) for 90 seconds on five separate occasions. Active and parked regeneration will be disabled.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL Balance)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Inlet Temperature (DPFIT) drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 895). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4766 FMI 16.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4766 FMI 16. Is EST DTC list SPN 4766 FMI 16 Active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check for failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module.	Decision
Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4766 FMI 16.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4766 FMI 16.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 4766 FMI 16.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FPC. After repairs are complete, retest for SPN 4766 FMI 16.

Step 7	Check for restricted exhaust.	Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4766 FMI 16. No: Clean or replace DOC. After repairs are complete, retest for SPN 4766 FMI 16.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4766 FMI 16 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

DPFOT Sensor (Diesel Particulate Filter Outlet Temperature)

Overview of DPFOT Sensor Group

SPN	FMI	Condition
3246	0	DPFOT above Critical Temperature (page 899)
3246	2	DPFOT signal erratic, intermittent, or incorrect (page 902)
3246	3	DPFOT signal Out of Range HIGH (page 904)
3246	4	DPFOT signal Out of Range LOW (page 906)
3246	15	DPFOT above Warning Temperature (page 908)
3246	16	DPFOT above Maximum Temperature (page 911)

Overview

Diesel Particulate Filter Outlet Temperature (DPFOT) sensor measures exhaust temperature at the outlet of the DPF. DOC / DPF temperature sensor module is a smart device that communicates with Aftertreatment Control Module (ACM) via Controller Area Network (CAN). DPFOT sensor is part of DOC / DPF temperature sensor module and is not serviceable individually.

SPN 3246 FMI 0 - DPFOT above Critical Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Outlet Temperature (DPFOT) above Critical Temperature	TBD	TBD

Fault Overview

Fault is set when Engine Control Module (ECM) detects Diesel Particulate Filter Outlet Temperature (DPFOT) sensor is above Critical Temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Outlet Temperature (DPFOT) sensor drops below critical limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 899). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 0.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3246 FMI 0. Is EST DTC list SPN 3246 FMI 0 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 0.

Step 4		Decision
Inspect turbocharger exhaust outlet for oil or fuel in the aftertreatment system from the engine. Remove exhaust plumbing from the turbocharger outlet. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3246 FMI 0.

Step 5		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is the AFT Fuel Injector (AFTFI) dry and free of fuel?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 0.

Step 6		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 0.

Step 7		Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform KOER Aftertreatment DPF Regeneration Procedure. After repairs are complete, retest for SPN 3246 FMI 0.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 3246 FMI 0.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3246 FMI 0 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3246 FMI 2 - DPFOT Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Particulate Filter Outlet Temperature (DPFOT) is not changing with engine operating conditions (in-range but not rational).	Average temperature drop across Diesel Oxidation Catalyst (DOC) > 99°F (55°C) or < -108°F (-60°C) Average temperature drop across Diesel Particulate Filter (DPF) > 99°F (55°C) or < -108°F (-60°C)	Key-On Engine-Running (KOER) Time since last active regeneration > 600 seconds Exhaust flow between 200 g/sec and 1,000 g/sec DPFOT between 217°F (103°C) and 1112°F (600°C) Inactive: SPN 3242 FMI 3 and 4 (DPFIT); SPN 3246 FMI 3 and 4 (DPFOT); SPN 3480 FMI 3, 4, and 17 (AFT: FP1); SPN 3482 FMI 3, 4, and 7 (AFT: FSV); SPN 4765 FMI 3 and 4 (DOCIT); SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF Temperature Sensor Module)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Diesel Particulate Filter Outlet Temperature (DPFOT) reading is not changing with engine operating conditions within 300 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3242 FMI 3 and 4 (DPFIT)	• SPN 3246 FMI 3 and 4 (DPFOT)	• SPN 3480 FMI 3, 4, and 17 (AFT: FP1)	• SPN 3482 FMI 3, 4, and 7 (AFT: FSV)
• SPN 4765 FMI 3 and 4 (DOCIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF Temperature Sensor Module)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 902). Is EST DTC list free of Associated Faults?		Yes: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 2.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3246 FMI 2 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3246 FMI 3 - DPFOT signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to power or OPEN in Diesel Particulate Filter Outlet Temperature (DPFOT) sensor circuit.	DPFOT sensor input voltage is ≥ 5V, or impedance is ≥ 10 Ω.	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that DPFOT sensor signal voltage is greater than expected for 16 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF temperature sensor module)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 904). Is EST DTC list free of Associated Faults?		Yes: Replace Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 3.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 3.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3246 FMI 3 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3246 FMI 4 - DPFOT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module detects short to ground in Diesel Particulate Filter Outlet Temperature (DPFOT) sensor circuit.	DPFOT sensor input voltage is ≤ 1 volt.	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that DPFOT sensor signal voltage is less than expected for 16 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5742 FMI 3, 4, 11, and 16 (DOC / DPF temperature sensor module)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 906). Is EST DTC list free of Associated Faults?		Yes: Replace Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 4.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 4.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3246 FMI 4 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3246 FMI 15 - DPFOT above Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Outlet Temperature (DPFOT) sensor above Warning Temperature	TBD	Key ON

Fault Overview

Fault is set when Engine Control Module (ECM) detects Diesel Particulate Filter Outlet Temperature (DPFOT) sensor is above Warning Temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Outlet Temperature (DPFOT) sensor drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 908). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 15.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3246 FMI 15. Is EST DTC list SPN 3246 FMI 15 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 15.

Step 4		Decision
Inspect turbocharger exhaust outlet for oil or fuel in the aftertreatment system from the engine. Remove exhaust plumbing from the turbocharger outlet. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3246 FMI 15.

Step 5		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is the AFT Fuel Injector (AFTFI) dry and free of fuel?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 15.

Step 6		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 15.

Step 7		Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform KOER Aftertreatment DPF Regeneration Procedure. After repairs are complete, retest for SPN 3246 FMI 15.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 3246 FMI 15.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3246 FMI 15 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3246 FMI 16 - DPFOT above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Diesel Particulate Filter Outlet Temperature (DPFOT) sensor above Maximum Temperature	TBD	Key ON

Fault Overview

Fault is set when Engine Control Module (ECM) detects Diesel Particulate Filter Outlet Temperature (DPFOT) sensor is above Maximum Temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (Engine)	• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 5742 FMI 3, 4, 11, and 16 (DOC)	

Fault Facts

This fault will go inactive after Diesel Particulate Filter Outlet Temperature (DPFOT) sensor drops below maximum limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck Open Aftertreatment Fuel Injector
- Leaking or stuck Open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed DOC / DPF temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 911). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3246 FMI 16.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3246 FMI 15. Is EST DTC list SPN 3246 FMI 15 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT) sensor to Diesel Particulate Filter Inlet (DPFIT) and DPF Outlet Temperature (DPFOT) sensor temperatures.	Decision
Perform Hot Run Sensor Comparison Test(page 2104). Is DOCIT, DPFIT, and DPFOT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace DOC / DPF temperature sensor module. After repairs are complete, retest for SPN 3246 FMI 16.

Step 4		Decision
Inspect turbocharger exhaust outlet for oil or fuel in the aftertreatment system from the engine. Remove exhaust plumbing from the turbocharger outlet. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to Step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 3246 FMI 16.

Step 5		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is the AFT Fuel Injector (AFTFI) dry and free of fuel?		Yes: Go to Step 6. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 16.

Step 6		Decision
Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC). Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7. No: Replace AFT: FEC. After repairs are complete, retest for SPN 3246 FMI 16.

Step 7		Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform KOER Aftertreatment DPF Regeneration Procedure. After repairs are complete, retest for SPN 3246 FMI 16.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 3246 FMI 16.

End Diagnostic Steps
After performing diagnostic steps, if SPN 3246 FMI 16 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

EBP Sensor (Exhaust Back Pressure)

Overview of EBP Sensor Group

SPN	FMI	Condition
1209	1	EBP below desired level (page 915)
1209	2	EBP signal erratic, intermittent, or incorrect (page 917)
1209	3	EBP signal Out of Range HIGH (page 919)
1209	4	EBP signal Out of Range LOW (page 924)

Overview

The Exhaust Back Pressure (EBP) sensor measures exhaust back pressure that allows the Engine Control Module (ECM) to control the Exhaust Gas Recirculation (EGR) system. The EBP sensor is installed in a tube connected to the exhaust manifold at the top right rear of the engine.

SPN 1209 FMI 1 - EBP below desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Back Pressure (EBP) below desired level	TBD	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) detects that Exhaust Back Pressure (EBP) is below desired level.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Biased EBP sensor or circuit
- Plugged EBP sensor tube
- Failed Turbocharger

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 1209 FMI 2 - EBP Signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Back Pressure (EBP) does not agree with Intake Manifold Pressure (IMP) sensor and Barometric Pressure (BARO) sensor.	[Absolute value of difference between BARO and IMP < 4.4 psi (30 kPa) AND Absolute value of difference between EBP and BARO > 4.4 psi (30 kPa) AND Absolute value of difference between EBP and IMP > 4.4 psi (30 kPa) AND Engine Wastegate Actuator Position Command] < 100%	Key ON Time after Key ON > 0 seconds Battery Voltage > 9 Volts AND < 16 Volts [1. Engine Speed < 50 RPM 2. Engine Fuel Mass Command < 10 mg/stk 3. Engine Wastegate Actuator Position Command < 100% 4. Engine Throttle position < 10% 5. Engine Exhaust Gas Recirculation Valve Position Command < 40% Minimum time entry conditions (1) through (5) > 2 seconds OR [Engine Speed < 100 RPM AND Engine Fuel Mass Command] < 100 mg/stk Inactive: SPN 102 FMI 3 and 4; SPN 108 FMI 3 and 4; SPN 1209 FMI 3 and 4.

Fault Overview

Fault sets when absolute pressure difference between Exhaust Back Pressure (EBP) and Barometric Pressure (BARO) and absolute pressure difference between EBP and Intake Manifold Pressure (IMP) are greater than 4.4 psi (30 kPa) for two seconds with Wastegate Actuator Position Command is less than 100%.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1209 FMI 3 and 4 (EBP)	• SPN 3509 FMI 3 and 4 (VREF 1)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Defective sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 917). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1209 FMI 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 1209 FMI 2. Is EST DTC list SPN 1209 FMI 2 active or pending?		Yes: Replace Exhaust Back Pressure (EBP) sensor. After repairs are complete, retest for SPN 1209 FMI 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Tests
After performing all diagnostic steps, if SPN 1209 FMI 2 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1209 FMI 3 - EBP Signal Out of Range HIGH

Condition/Description	Setting Criteria	Enable Conditions/Values
Exhaust Back-Pressure (EBP) Sensor signal Out of Range High.	Exhaust Back-Pressure (EBP) sensor signal voltage is greater than 4.8 volts	Key ON SPN 3509 FMIs 3 and 4 are not active

Fault Overview

Fault sets when Exhaust Back-Pressure (EBP) sensor signal voltage is greater than 4.8 volts for 2.5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

A restricted exhaust system may set this fault.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EBP signal short to battery
- Failed EBP sensor
- Open SIG GND

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 919). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1209 FMI 3.

Step 2	Inspect connections at Exhaust Back Pressure (EBP) sensor.	Decision
A. Key OFF. B. Disconnect EBP sensor connector. C. Check EBP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBP sensor, connector harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1209 FMI 3.

Pin-Point Tests (SPN 1209 FMI 3)

EBP Circuit

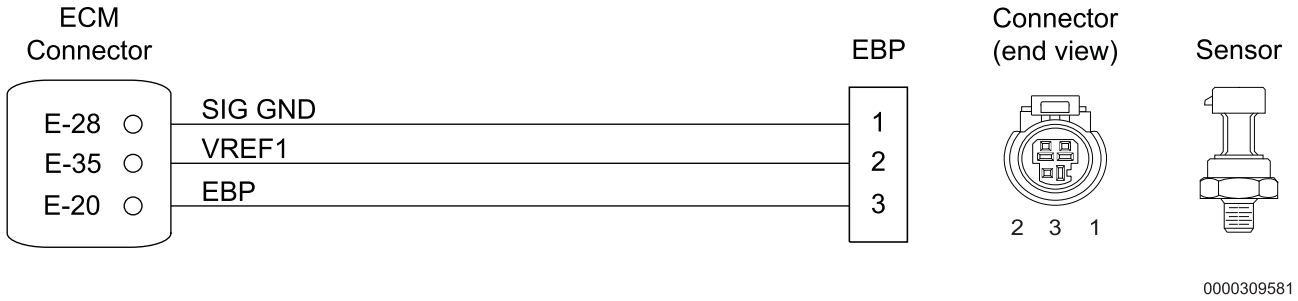


Figure 332 EBP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Tools Required

- Breakout Harness ZTSE4850
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect EBP sensor connector and leave EBP sensor disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 1209 FMI 3
Decision	
Does SPN 1209 FMI 3 set after DTC list is cleared?	Yes: Repair short to power between EBP pin-3 and Engine Control Module (ECM) Pin E-20. After repairs are complete, retest for SPN 1209 FMI 3.
	No: Go to Test 2.

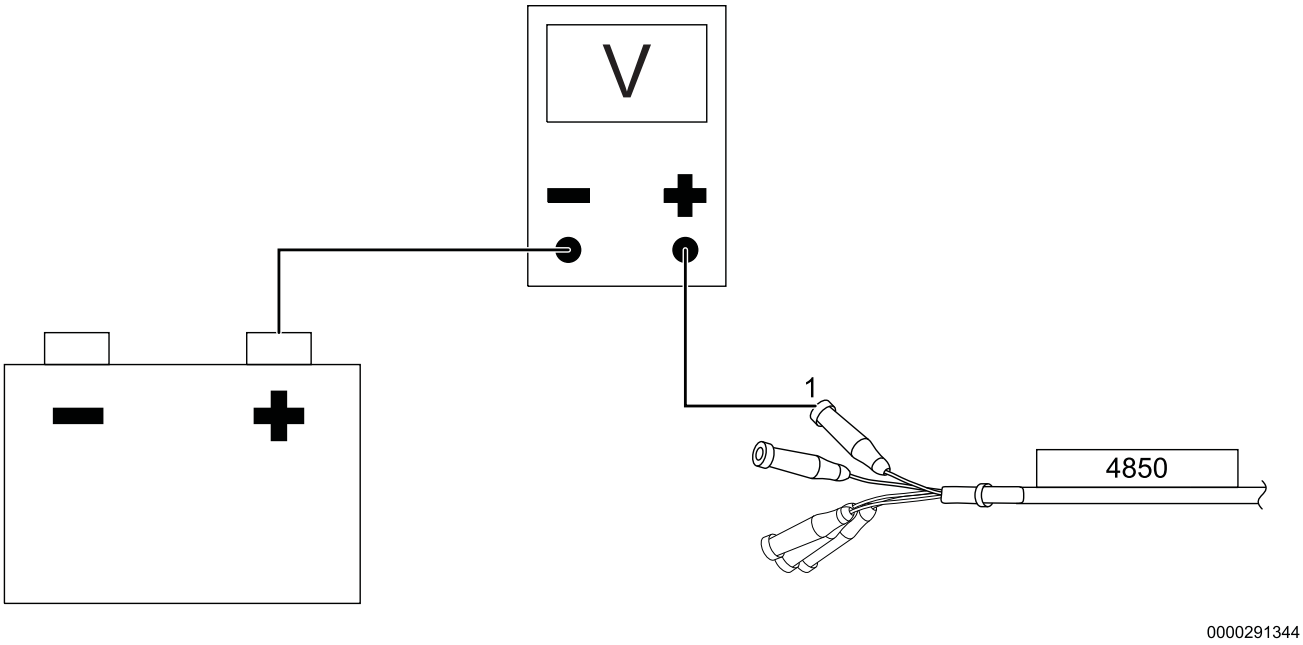


Figure 333 Test 2 EBP Sensor Circuit

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to EBP vehicle harness and leave EBP sensor disconnected C. Key ON.

Test 2	Specification
Use a DMM to measure voltage between ZTSE4850 pin-1 and B+.	B+
Decision	
Is the measure voltage B+?	Yes: Replace EBP sensor. After repairs are complete, retest for SPN 1209 FMI 3.
	No: Repair Open between EBP pin-1 and Engine Control Module (ECM) pin E-28. After repairs are complete, retest for SPN 1209 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 1209 FMI 3 fault code diagnostics.

SPN 1209 FMI 4 - EBP Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions/Values
Engine Exhaust Gas Pressure Sensor signal Out of Range Low	Exhaust Back Pressure Sensor Voltage less than 0.2 volts	Key ON SPN 3509 FMI 3 and 4 are NOT active

Fault Overview

Fault sets when Exhaust Back Pressure (EBP) sensor voltage less than 0.2 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EBP signal circuit Open
- EBP signal circuit short to GND
- VREF Open
- Failed EBP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 924). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3509 FMI 3 and 4.

Step 2	Inspect connections at Exhaust Back-Pressure (EBP) sensor.	Decision
A. Key OFF. B. Disconnect EBP sensor connector. C. Check EBP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the EBP sensor, connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1209 FMI 4.

Pin-Point Tests (SPN 1209 FMI 4)

EBP Circuit

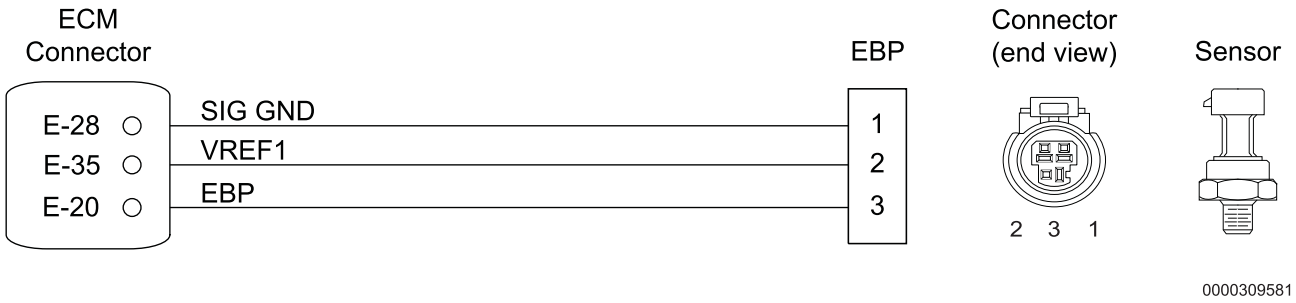


Figure 334 Exhaust Back Pressure (EBP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

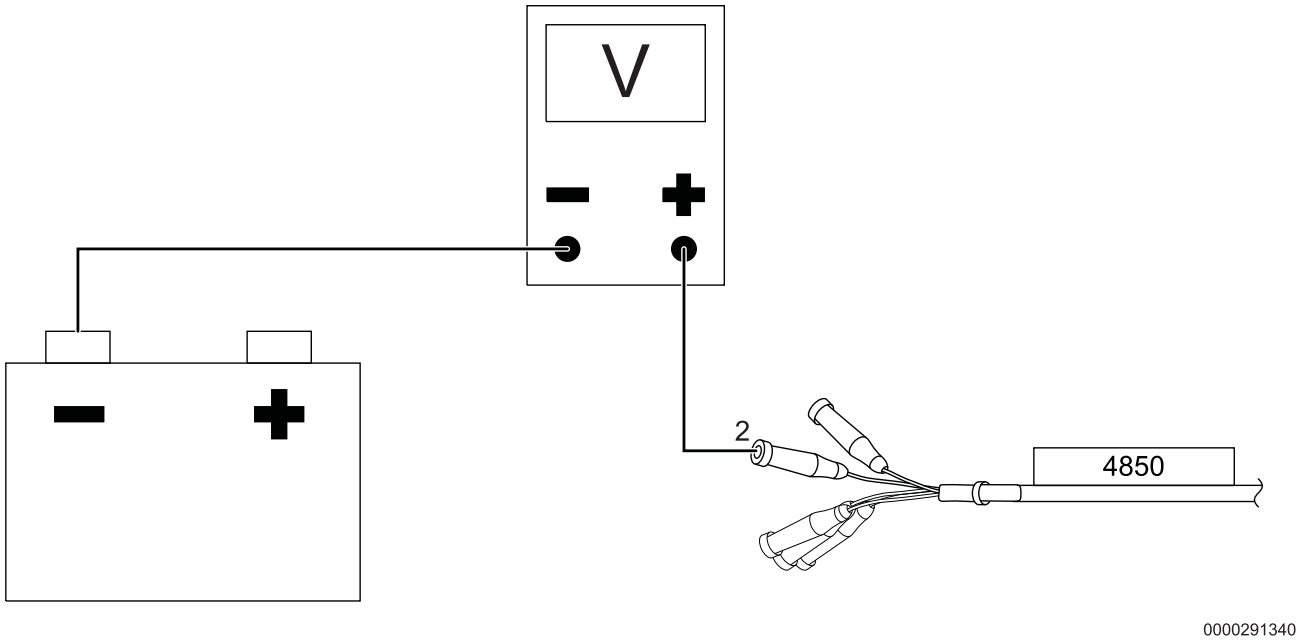
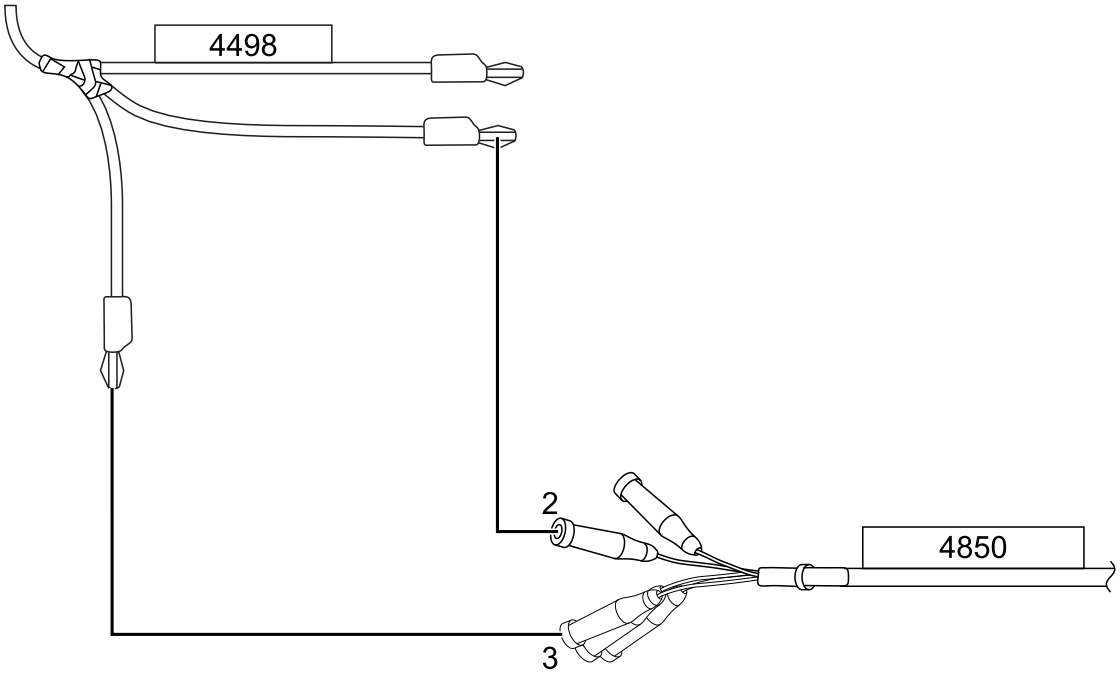


Figure 335 Test 1 EBP Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave EBP sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.	5 ± 1.0 volts
Decision	
Is voltage 5 ± 1.0 volts?	Yes: Go to Test 2.
	No: Repair Open between EBP pin-2 and Engine Control Module pin E-35. After repairs are complete, retest for SPN 1209 FMI 4.

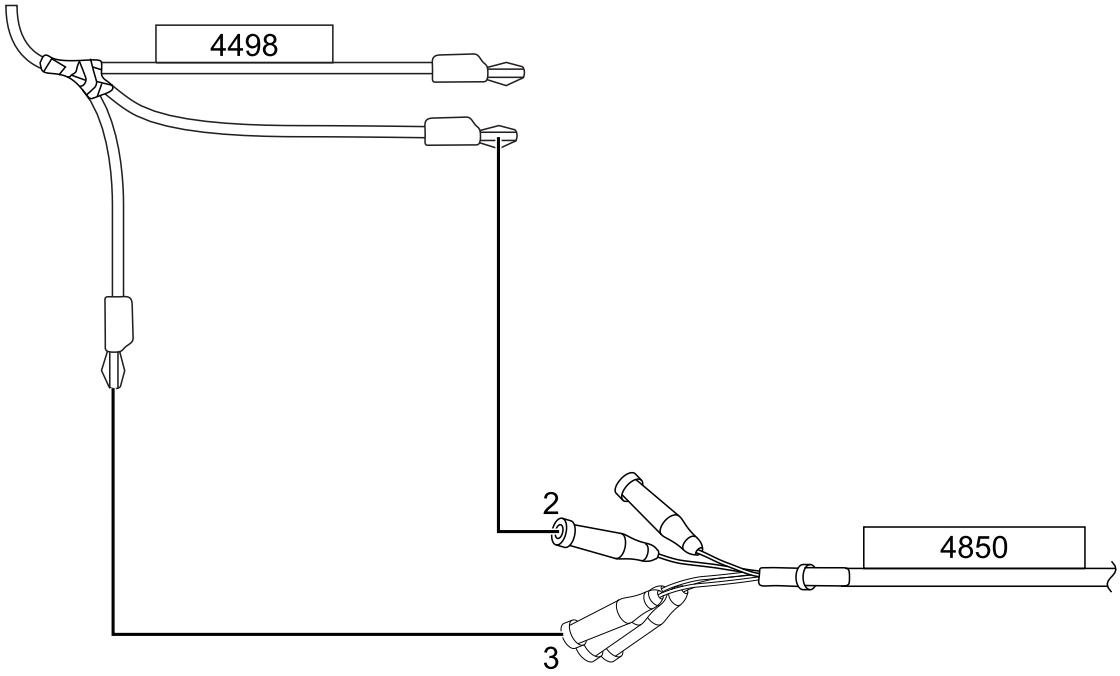


0000304541

Figure 336 Test 2 EBP Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave EBP sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Use EST with ServiceMaxx™ software to clear Diagnostic Trouble Code (DTC) list.	SPN 1209 FMI 3
Decision	
Does SPN 1209 FMI 3 set after DTC list is cleared?	Yes: Replace EBP sensor. After repairs are complete, retest for SPN 1209 FMI 4.
	No: Go to Test 3.



0000304541

Figure 337 Test 3 EBP Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave EBP sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Use EST with ServiceMaxx™ to clear DTC list.	SPN 3509 FMI 4
Decision	
Does SPN 3509 FMI 4 set?	Yes: Repair short to ground between EBP pin-3 and Engine Control Module (ECM) pin E-20. After repairs are complete, retest for SPN 1209 FMI 4.
	No: Repair Open between EBP pin-3 and ECM pin E-20. After repairs are complete, retest or SPN 1209 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 1209 FMI 4 fault code diagnostics.

EBPV (Exhaust Back Pressure Valve)

Overview of EBPV Sensor Group

SPN	FMI	Condition
5541	2	TC1TOP signal erratic, intermittent or incorrect (page 931)
5541	3	TC1TOP signal Out of Range HIGH (page 933)
5541	4	TC1TOP signal Out of Range LOW (page 942)
5542	15	TC1TOP Above Desired (page 948)
5542	17	TC1TOP Below Desired (page 950)
5543	3	EBPC short to PWR (page 952)
5543	4	EBPC short to GND (page 961)
5543	5	EBPC open load/circuit (page 967)

Overview

Engine Control Module (ECM) commands EBPV (Exhaust Back Pressure Valve) to control the exhaust brake. EBPV is installed in exhaust pipe.

SPN 5541 FMI 2 - TC1TOP signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of Engine Turbocharger 1 Turbine Outlet Pressure with any of the following pressure sensors: a. Engine Intake Manifold 1 Pressure Sensor OR b. Barometric Pressure Sensor OR c. Engine Exhaust Back Pressure Sensor.	Absolute Value of difference between Engine Turbocharger 1 Turbine Outlet Pressure and the following sensors: a. Engine Intake Manifold 1 Pressure > 3.6 psi (25 kPa) (OR) b. Engine Exhaust Gas Pressure > 3.6 psi (25 kPa) (OR) c. Barometric Pressure > 3.6 psi (25 kPa)	Key ON Engine Speed ≤ 50 RPM SPN / FMI 1209/3, 1209/4, 102/3, 102/4, 108/3, 108/4, and 1387/31 are NOT active

Function

Fault set when comparison of Turbocharger 1 Turbine Outlet Pressure (TC1TOP) to Intake Manifold Pressure (IMP), Barometric Absolute Pressure (BARO), or Exhaust Back Pressure (EBP) has an absolute pressure value difference of greater than 3.6 psi (25 kPa).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Biased Turbocharger 1 Turbine Outlet Pressure (TC1TOP) sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 931). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5541 FMI 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 5541 FMI 2. Is EST DTC list SPN 5541 FMI 2 active or pending?		Yes: Replace TC1TOP sensor. After repairs are complete, retest for SPN 5541 FMI 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Tests
After performing all diagnostic steps, if SPN 5541 FMI 2 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5541 FMI 3 - TC1TOP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Turbocharger 1 Turbine Outlet Pressure (TC1TOP) signal Out of Range High	Engine Turbocharger 1 Turbine Outlet Pressure sensor pressure voltage > 4.8 Volts (> 537.1 kPa)	Key ON SPN / FMI 3509/3 and 3509/4 are NOT active

Fault Overview

Fault is set when Engine Control Module (ECM) detects Turbocharger 1 Turbine Outlet Pressure (TC1TOP) signal is out of range HIGH.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Signal SCB
- SRTN Open
- Failed Sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 933). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5541 FMI 3.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 5541 FMI 3. Is EST DTC list SPN 5541 FMI 3 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 5541 FMI 3)

EBPC Circuit

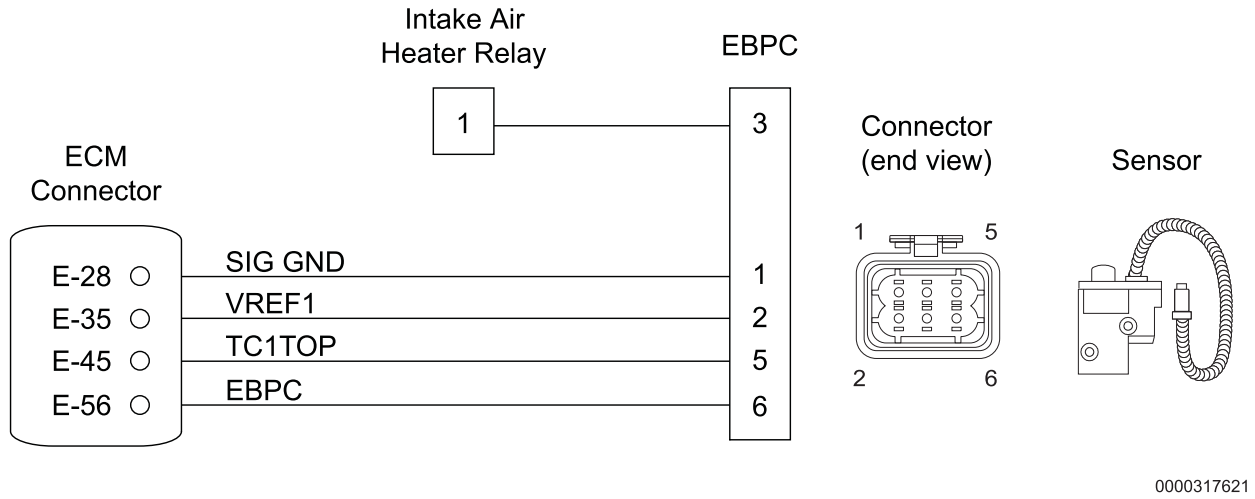


Figure 338 Exhaust Back Pressure Valve (EBPV) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4834
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM) ZTSE4357

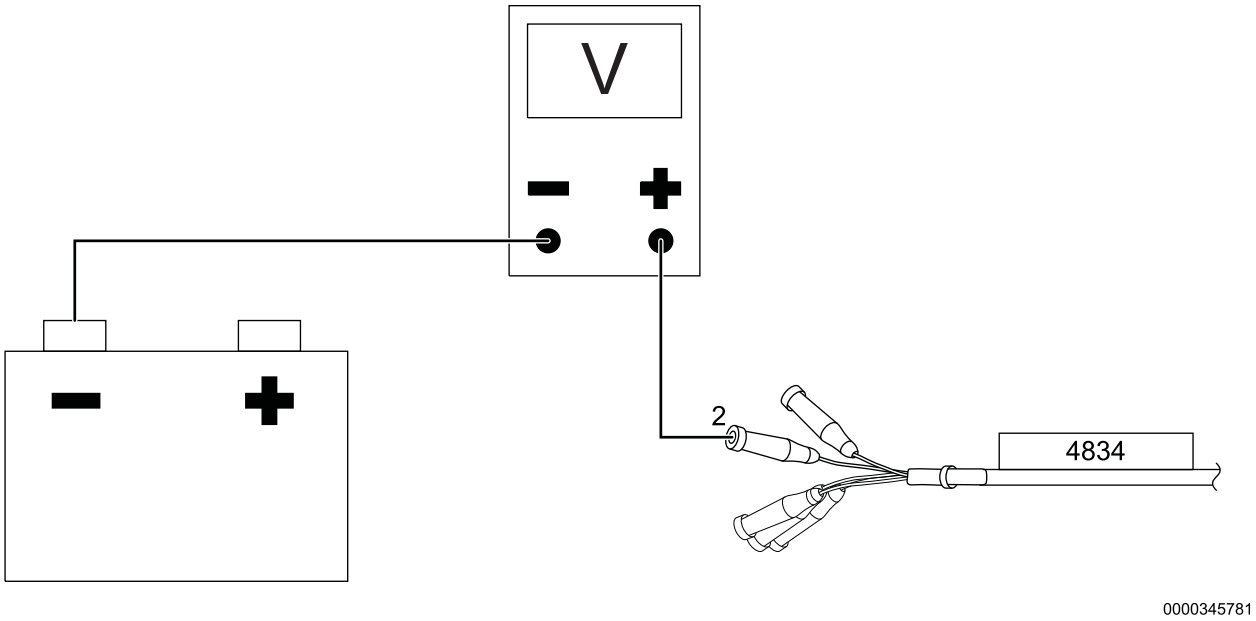
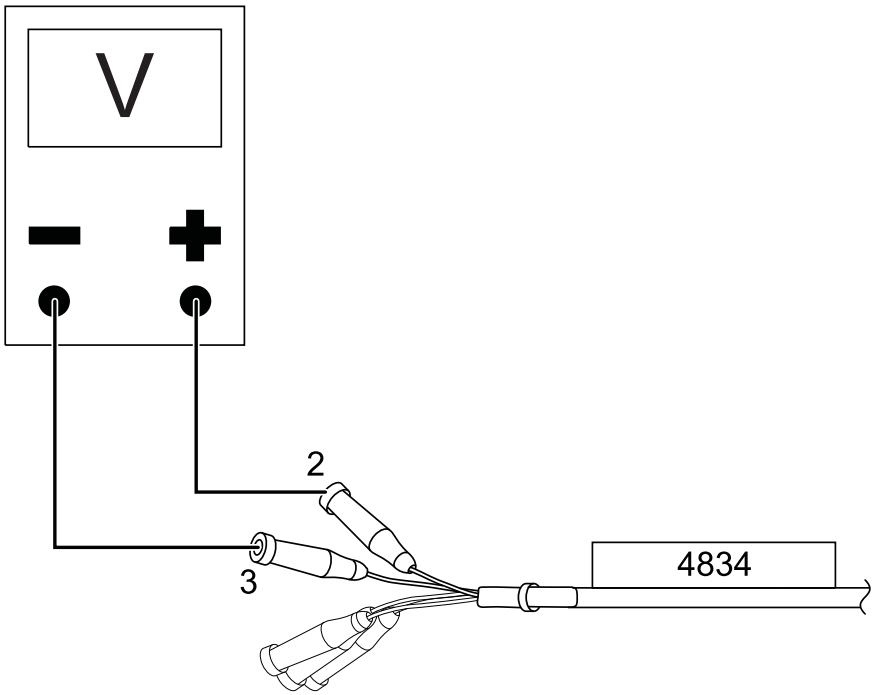


Figure 339 Test 1 VREF 1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open or short to GND in VREF 1 between Engine Control Module (ECM) pin E-35 and EBPV pin-2. After repairs are complete, retest for SPN 5541 FMI 3.

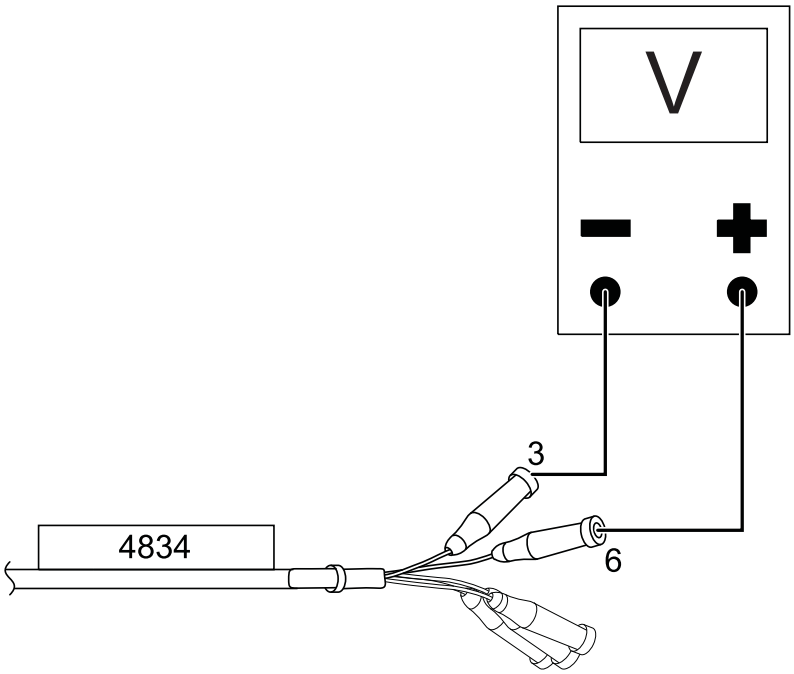


0000346082

Figure 340 Test 2 ACT GND Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and pin-3.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 4.



0000346101

Figure 341 Test 3 EBPV Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-6 and pin-3.	Less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Repair short to power in EBPC circuit between EBPV pin-6 and ECM pin E-56. After repairs are complete, retest for SPN 5541 FMI 3.
	No: Replace EBPV. After repairs are complete, retest for SPN 5541 FMI 3.

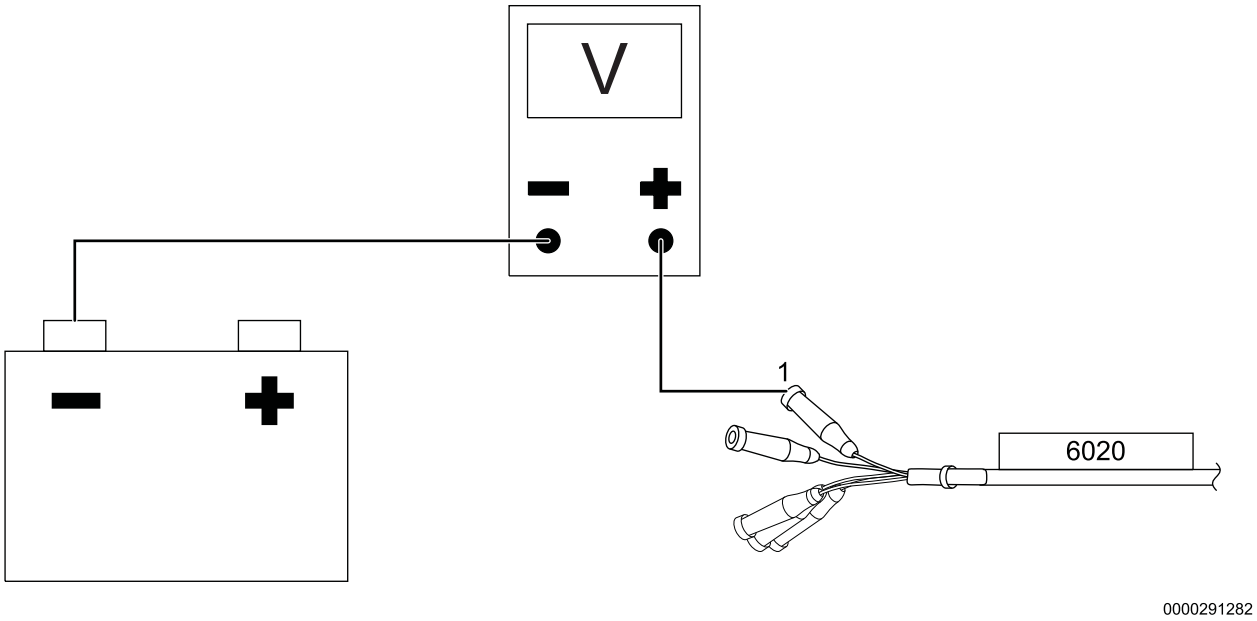
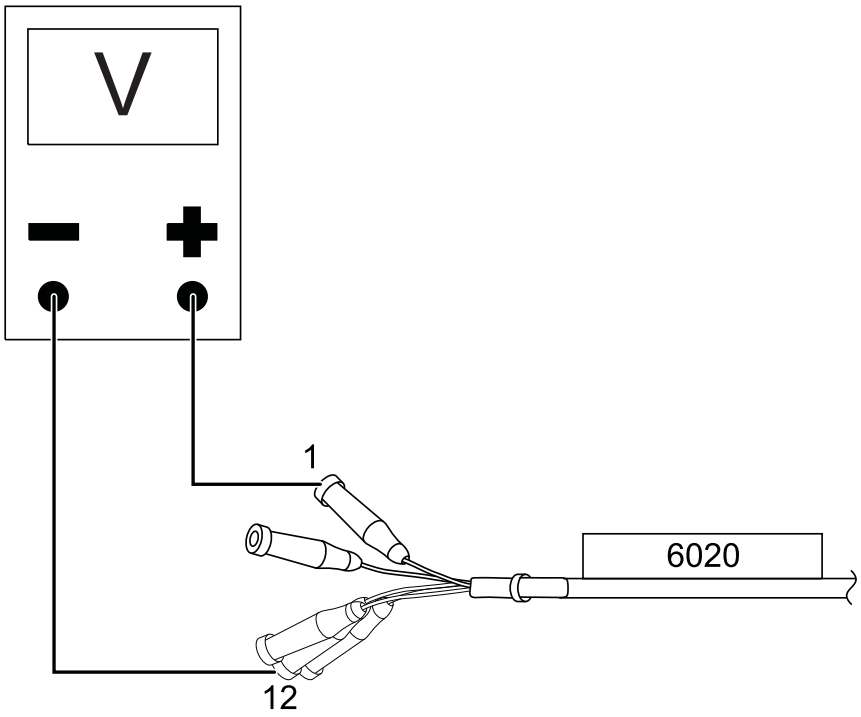


Figure 342 Test 4 ACT PWR Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis Connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave engine side disconnected. D. Key ON.

Test 4	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6020 pin-1 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 5.
	No: Repair open in ACT PWR between 24-pin engine to chassis pin-1 connector and ACT PWR Relay pin-87. After repairs are complete, retest for SPN 5541 FMI 3.



0000291288

Figure 343 Test 5 24-Pin Engine to Chassis ACT GND Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis Connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave engine side disconnected. D. Key ON.

Test 5	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6020 pin-1 and pin-12.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair open in ACT GND between 24-pin engine to chassis connector pin-12 and EBPV pin-1. After repairs are complete, retest for SPN 5541 FMI 3.
	No: Repair open in ACT GND between 24-pin engine to chassis connector pin-12 and chassis ground connection pin C-2,4,6. After repairs are complete, retest for SPN 5541 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5541 FMI 3 fault code diagnostics.

SPN 5541 FMI 4 - TC1TOP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Turbocharger 1 Turbine Outlet Pressure signal Out of Range Low	Engine Turbocharger 1 Turbine Outlet Pressure sensor pressure voltage < 0.2 Volts (< 0 kPa)	Key ON SPN / FMI 3509/3 and 3509/4 are NOT active

Fault Overview

Fault is set when Engine Control Module (ECM) detects Turbocharger 1 Turbine Outlet Pressure (TC1TOP) signal is out of range LOW.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Signal Open
- Signal SCG
- VREF Open

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 942). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5541 FMI 4.

Step 2	Inspect connections at Exhaust Back Pressure Valve (EBPV) Control.	Decision
A. Key OFF. B. Disconnect EBPV control. C. Check EBPV control and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBPV control connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5541 FMI 4.

Pin-Point Tests (SPN 5541 FMI 4)

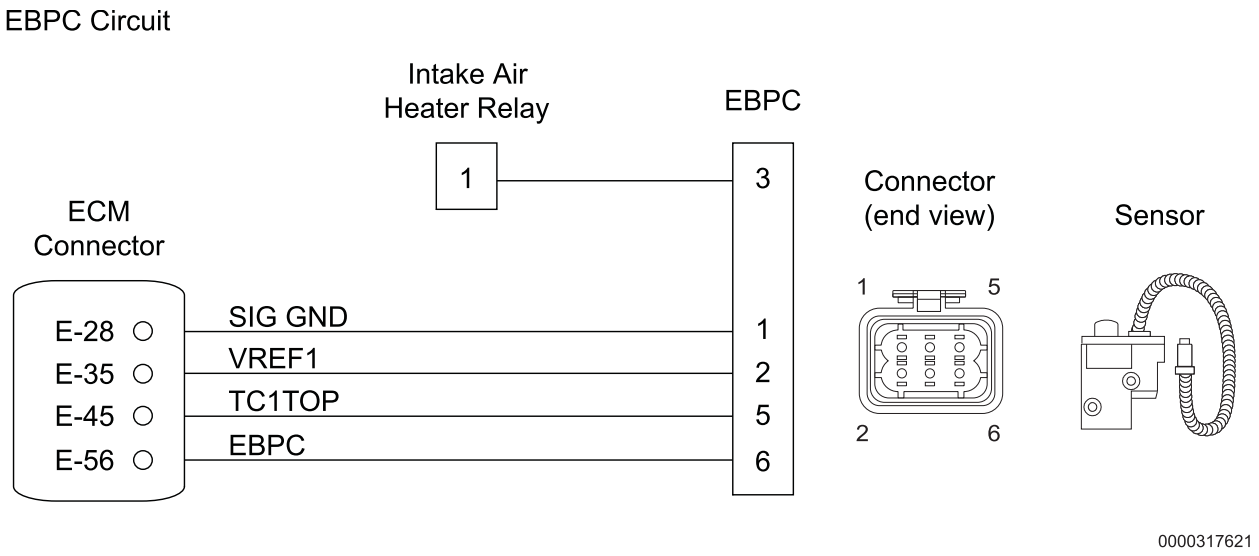


Figure 344 Exhaust Back Pressure Valve (EBPV) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4834
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM) ZTSE4357

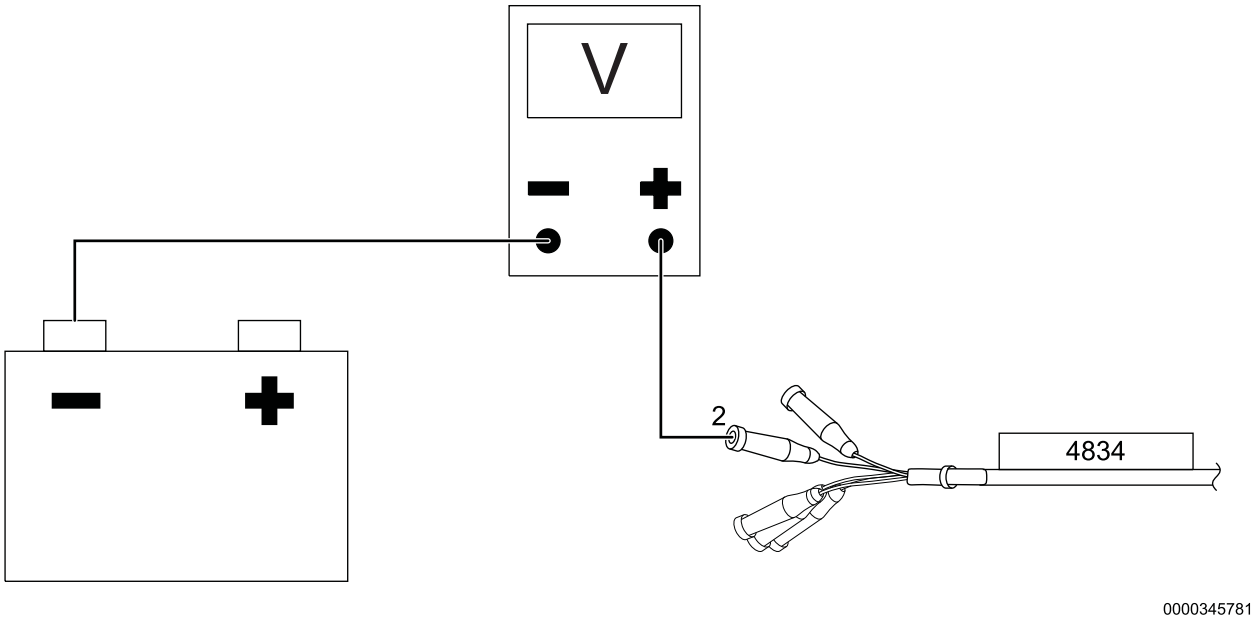
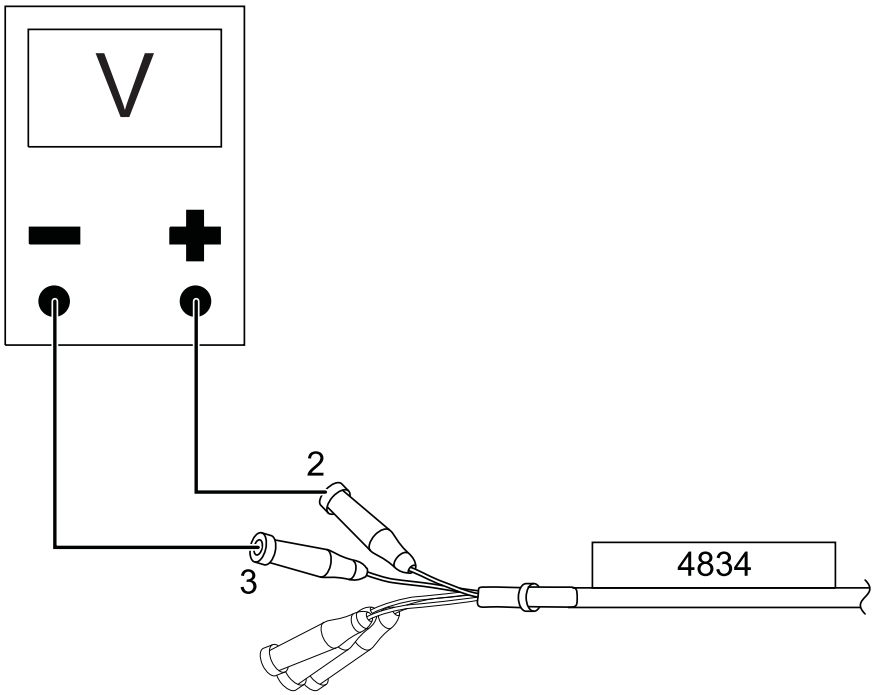


Figure 345 Test 1 VREF 1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open or short to GND in VREF 1 between Engine Control Module (ECM) pin E-35 and EBPV pin-2. After repairs are complete, retest for SPN 5541 FMI 4.



0000346082

Figure 346 Test 2 EBPV short to GND Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4834 pin-6 and known good GND.	Less than 1000 ohms
Decision	
Is resistance less than 1000 ohms?	Yes: Repair short to GND in EBPV control circuit between Engine Control Module (ECM) pin E-56 and EBPV pin-6. After repairs are complete, retest for SPN 5541 FMI 4.
	No: Go to Test 3.

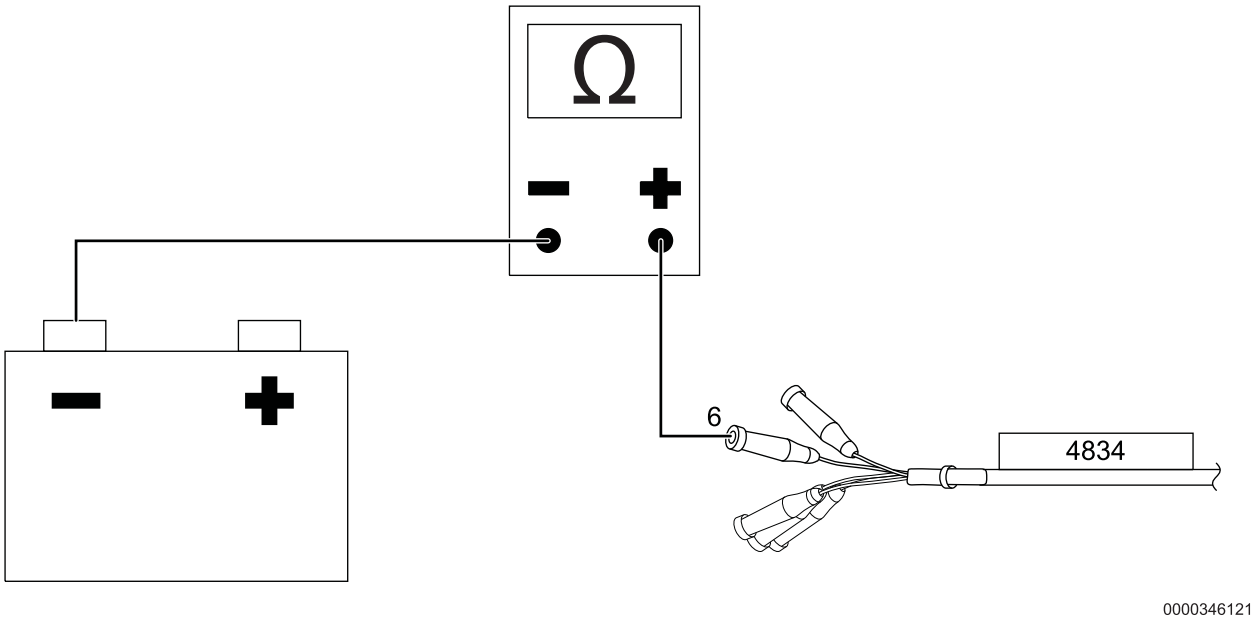


Figure 347 Test 3 EBPV Open Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4834 pin-6 and known good GND.	Less than 1000 ohms
Decision	
Is resistance less than 1000 ohms?	Yes: Repair short to GND in EBPV control circuit between Engine Control Module (ECM) pin E-56 and EBPV pin-6. After repairs are complete, retest for SPN 5541 FMI 4.
	No: Replace EBPV. After repairs are complete, retest for SPN 5541 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5541 FMI 4 fault code diagnostics.

SPN 5542 FMI 15 - TC1TOP Above Desired

Condition / Description	Setting Criteria	Enable Conditions / Condition Values

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 5542 FMI 17 - TC1TOP Below Desired

Condition / Description	Setting Criteria	Enable Conditions / Condition Values

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 5543 FMI 3 - EBPC short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Back Pressure Valve (EBPV) Control circuit short to Power	Current on the driver > 8 A for 100 microseconds	Key On Battery Voltage > 9 Volts Engine Exhaust Brake Actuator driver enabled SPN / FMI 158/15 and 158/17 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) detects Exhaust Back Pressure Valve (EBPV) Control circuit is shorted to power.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 158 FMI 15 and 17 (ECM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EBPV circuit short to PWR
- Failed EBPV valve

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 952). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5543 FMI 3.

Step 2	Inspect connections at Exhaust Back Pressure Valve (EBPV) connector.	Decision
A. Key OFF. B. Disconnect EBPV connector. C. Check EBPV control and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBPV control connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5543 FMI 3.

Pin-Point Tests (SPN 5543 FMI 3)

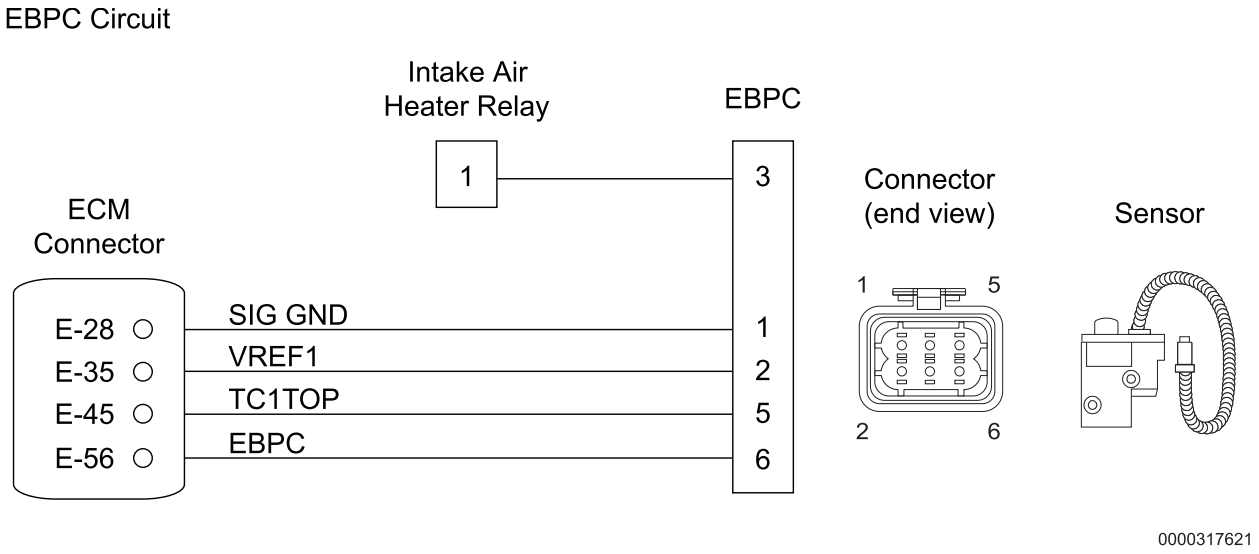


Figure 350 Exhaust Back Pressure Valve (EBPV) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4834
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM) ZTSE4357

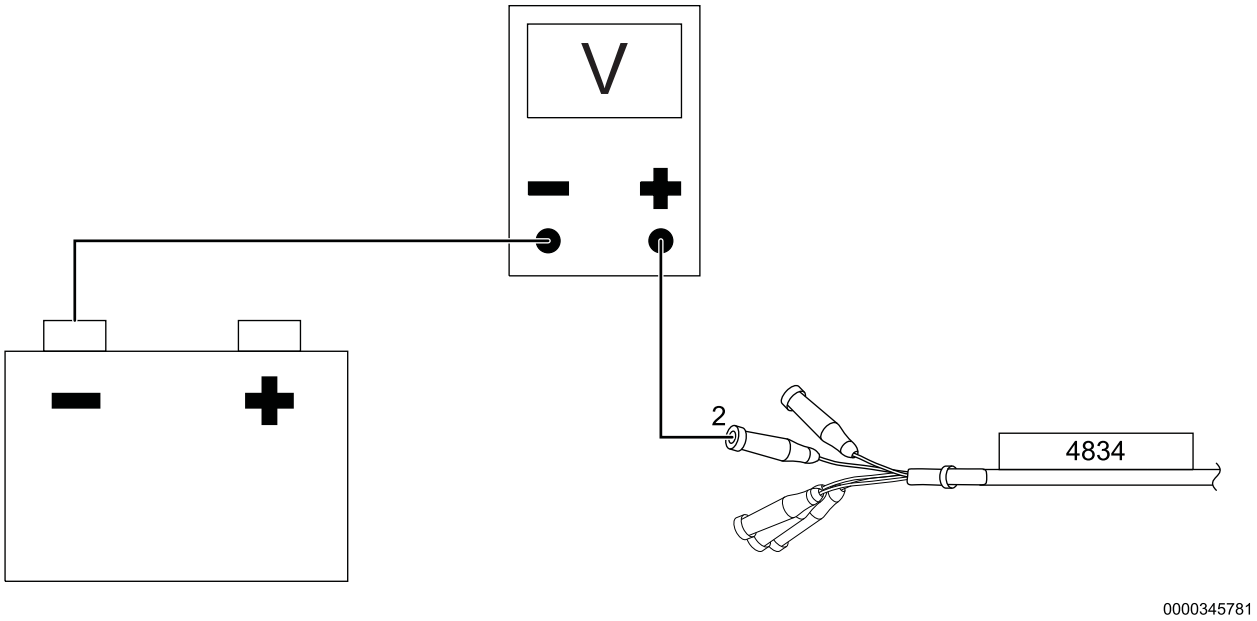
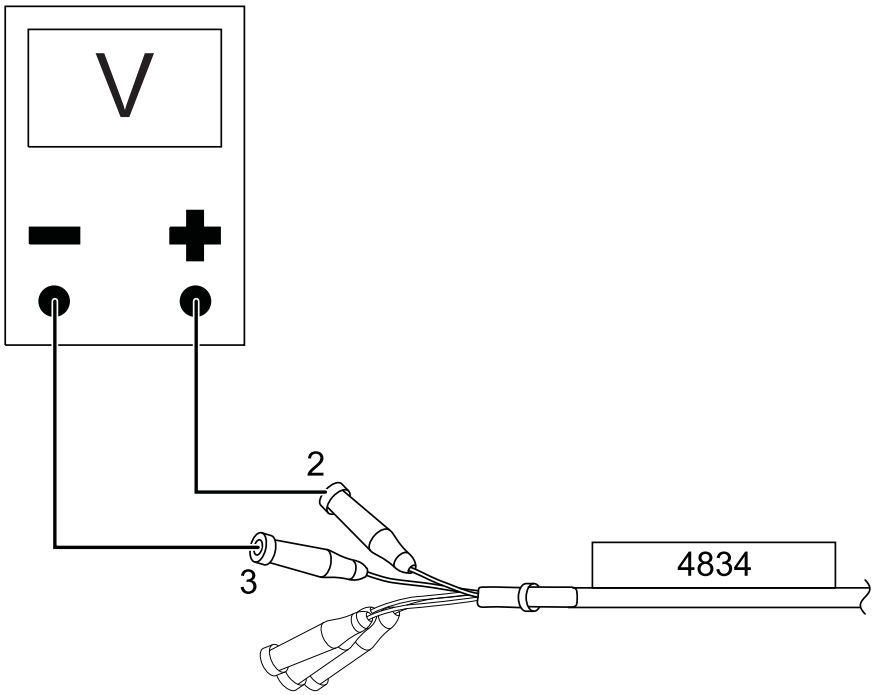


Figure 351 Test 1 VREF 1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open or short to GND in VREF 1 between Engine Control Module (ECM) pin E-35 and EBPV pin-2. After repairs are complete, retest for SPN 5543 FMI 3.

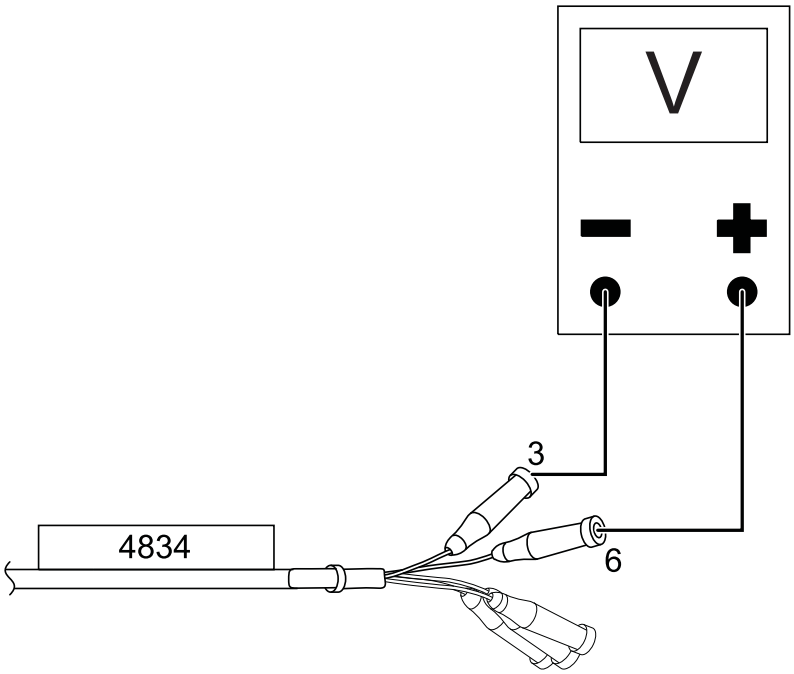


0000346082

Figure 352 Test 2 ACT GND Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and pin-3.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 4.



0000346101

Figure 353 Test 3 EBPV Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-6 and pin-3.	Less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Repair short to power in EBPC circuit between EBPV pin-6 and ECM pin E-56. After repairs are complete, retest for SPN 5543 FMI 3.
	No: Replace EBPV. After repairs are complete, retest for SPN 5543 FMI 3.

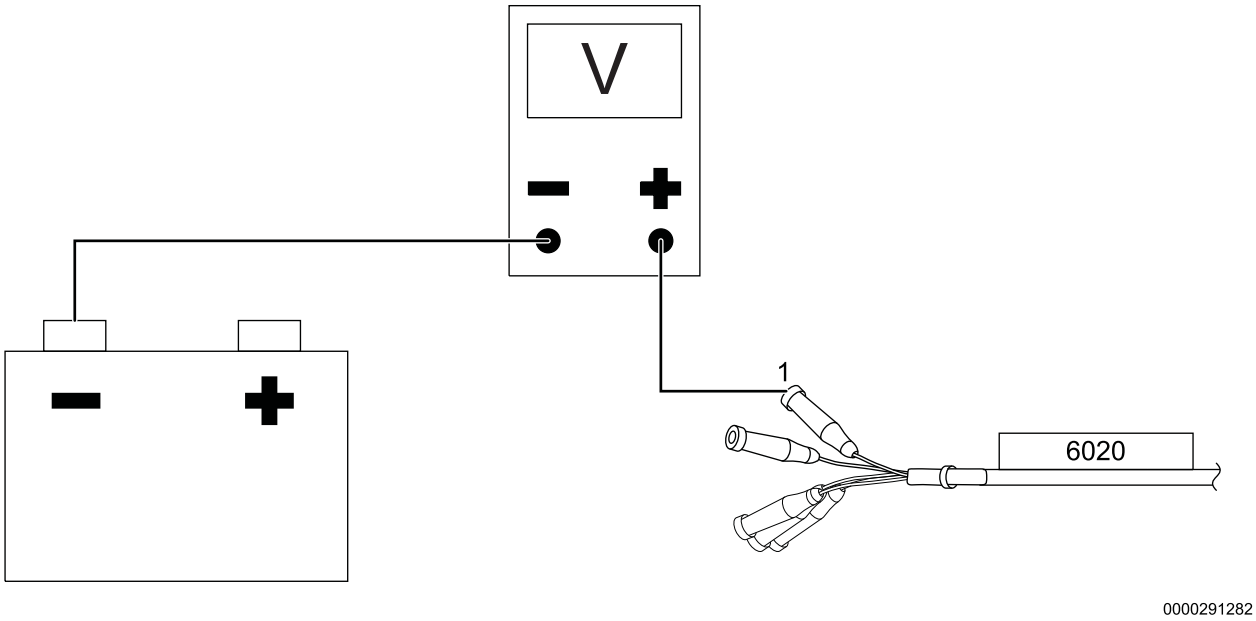
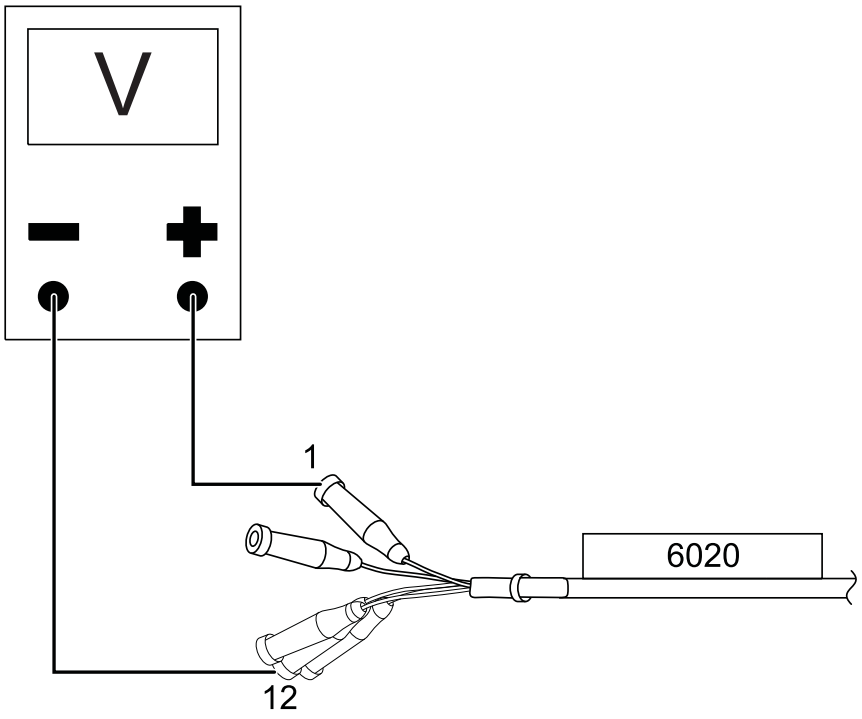


Figure 354 Test 4 ACT PWR Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis Connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave engine side disconnected. D. Key ON.

Test 4	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6020 pin-1 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 5.
	No: Repair open in ACT PWR between 24-pin engine to chassis pin-1 connector and ACT PWR Relay pin-87. After repairs are complete, retest for SPN 5543 FMI 3.



0000291288

Figure 355 Test 5 24-Pin Engine to Chassis ACT GND Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis Connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave engine side disconnected. D. Key ON.

Test 5	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6020 pin-1 and pin-12.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair open in ACT GND between 24-pin engine to chassis connector pin-12 and EBPV pin-1. After repairs are complete, retest for SPN 5543 FMI 3.
	No: Repair open in ACT GND between 24-pin engine to chassis connector pin-12 and chassis ground connection pin C-2,4,6. After repairs are complete, retest for SPN 5543 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5543 FMI 3 fault code diagnostics.

SPN 5543 FMI 4 - EBPC short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Back Pressure Valve (EBPV) Control Circuit Short to Ground	Current on the driver > 8 A for 100 microseconds	Key On Battery Voltage > 9 Volts Engine Exhaust Brake Actuator driver enabled SPN / FMI 158/15 and 158/17 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) detects Exhaust Back Pressure Valve (EBPV) Control circuit is shorted to ground.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 158 FMI 15 and 17 (ECM)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EBPV circuit short to GND
- Failed EBPV valve

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 961). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5543 FMI 4.

Step 2	Inspect connections at Exhaust Back Pressure Valve (EBPV) connector.	Decision
A. Key OFF. B. Disconnect EBPV connector. C. Check EBPV control and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBPV control connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5543 FMI 4.

Pin-Point Tests (SPN 5543 FMI 4)

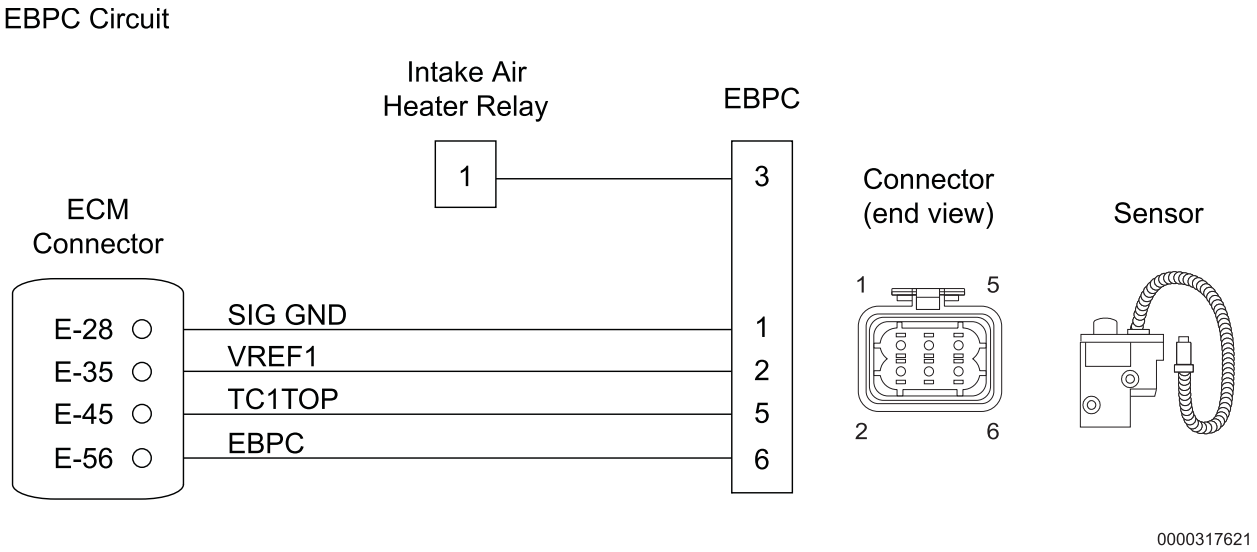


Figure 356 Exhaust Back Pressure Valve (EBPV) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4834
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM) ZTSE4357

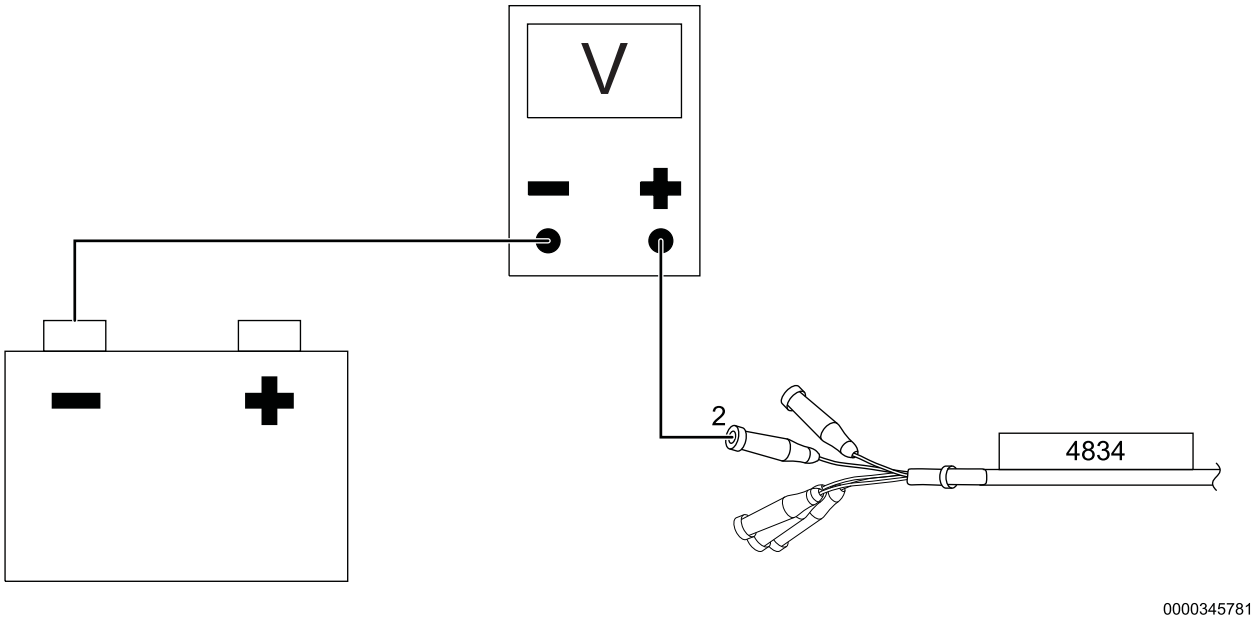
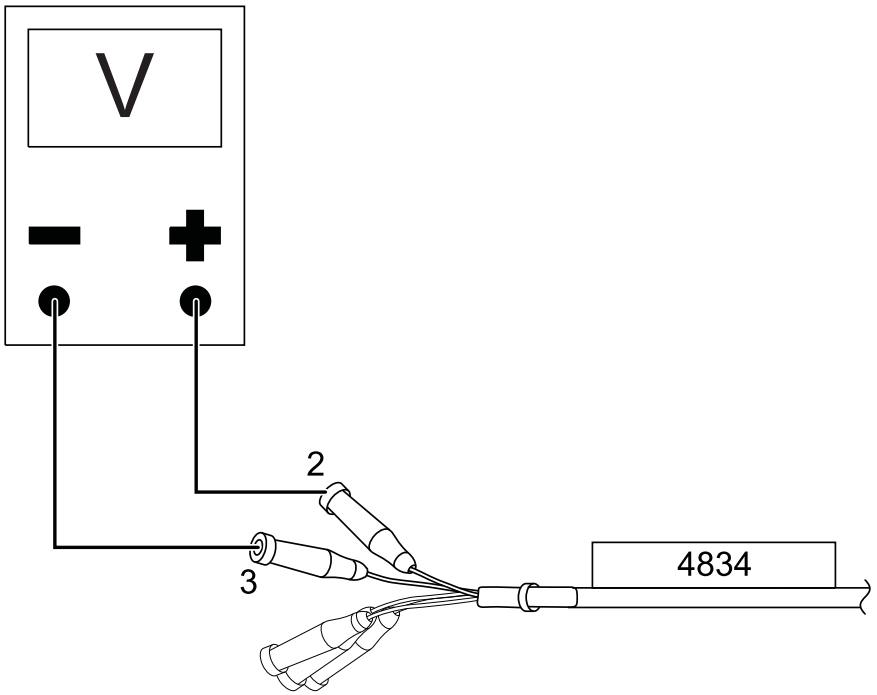


Figure 357 Test 1 VREF 1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4834 pin-2 and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open or short to GND in VREF 1 between Engine Control Module (ECM) pin E-35 and EBPV pin-2. After repairs are complete, retest for SPN 5543 FMI 4.



0000346082

Figure 358 Test 2 EBPV short to GND Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4834 pin-6 and known good GND.	Less than 1000 ohms
Decision	
Is resistance less than 1000 ohms?	Yes: Repair short to GND in EBPV control circuit between Engine Control Module (ECM) pin E-56 and EBPV pin-6. After repairs are complete, retest for SPN 5543 FMI 4.
	No: Go to Test 3.

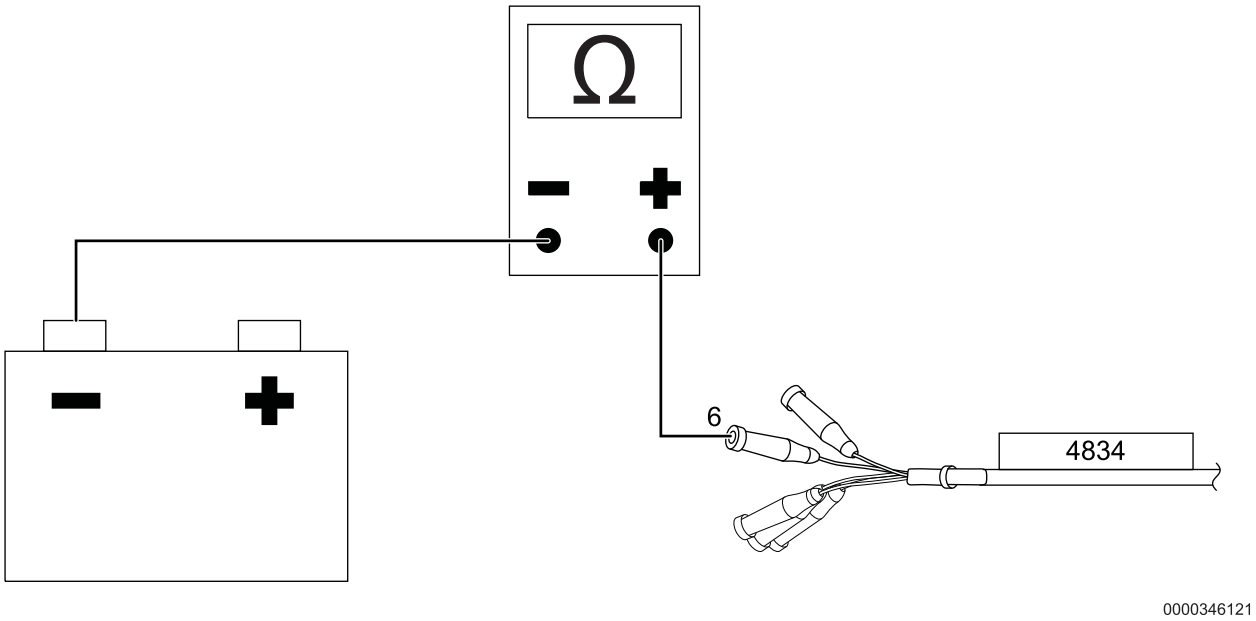


Figure 359 Test 3 EBPV Open Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4834 pin-6 and known good GND.	Less than 1000 ohms
Decision	
Is resistance less than 1000 ohms?	Yes: Repair short to GND in EBPV control circuit between Engine Control Module (ECM) pin E-56 and EBPV pin-6. After repairs are complete, retest for SPN 5543 FMI 4.
	No: Replace EBPV. After repairs are complete, retest for SPN 5543 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 5543 FMI 4 fault code diagnostics.

SPN 5543 FMI 5 - EBPC open load/circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Brake Actuator Circuit Open Circuit	Current on driver < 25 mA for 100 microseconds	Key On Battery Voltage > 9 Volts Engine Exhaust Brake Actuator driver enabled SPN / FMI 158/15 and 158/17 are NOT active

Fault Overview

Fault sets when Exhaust Back Pressure Control (EBPC) is less than 25 mA for 100 microseconds when enabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 158 FMI 15 and 17 (ECM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust Back Pressure Control (EBPC) circuit Open
- ACT GND circuit Open
- Failed Exhaust Back Pressure Valve (EBPV)

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 967). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5543 FMI 5.

Step 2	Inspect connections at Exhaust Back Pressure Control (EBPC) connector.	Decision
A. Key OFF B. Disconnect EBPC C. Check EBPC and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBPC connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5543 FMI 5.

Pin-Point Tests (SPN 5543 FMI 5)

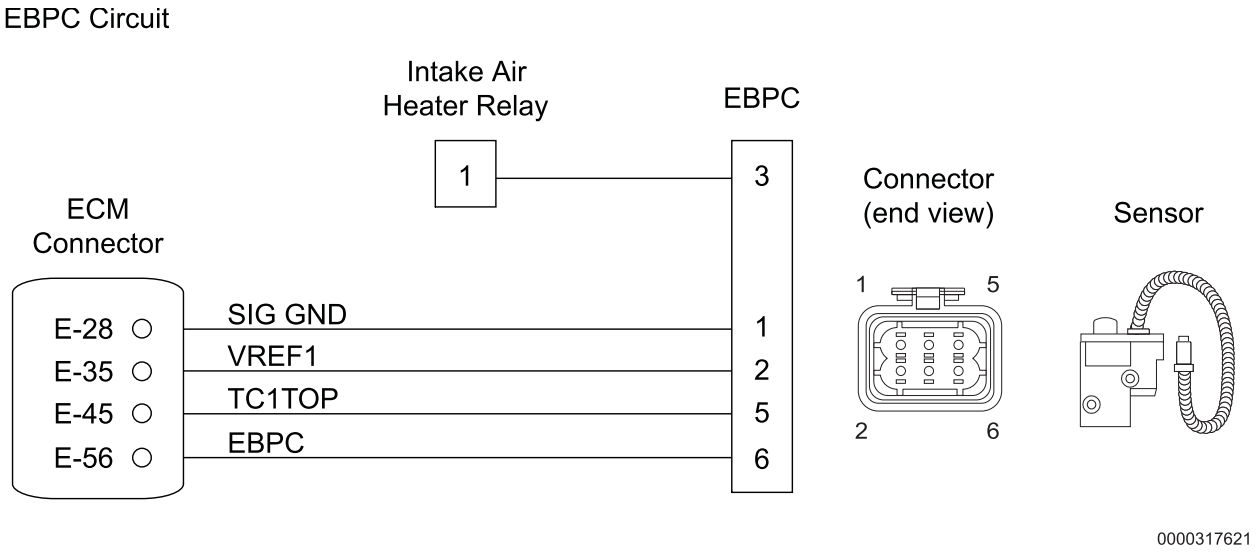


Figure 360 Exhaust Back Pressure Valve (EBPV) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4834
- Digital Multimeter (DMM)

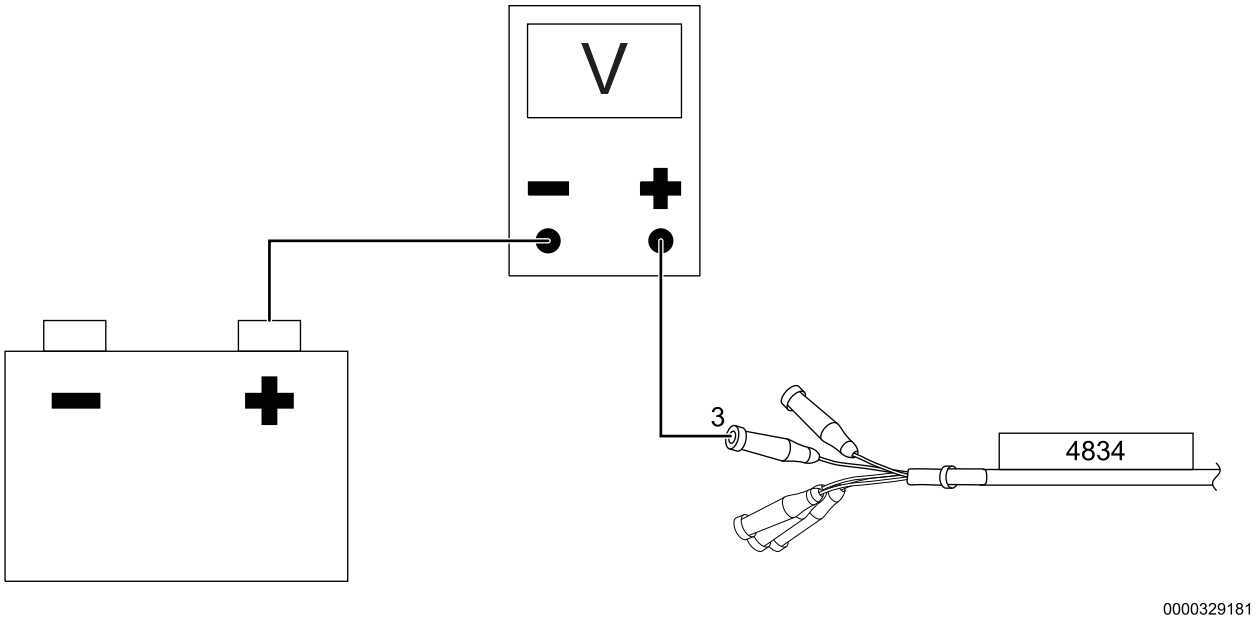


Figure 361 Test 1 Exhaust Back Pressure Valve (EBPV) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV connector disconnected. D. Key ON.

Test 1	Specification
Using DMM measure voltage between Breakout Harness ZTSE4834 pin-3 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open between EBPV pin-3 and ACT GND. After repairs are complete, retest for SPN 5543 FMI 5

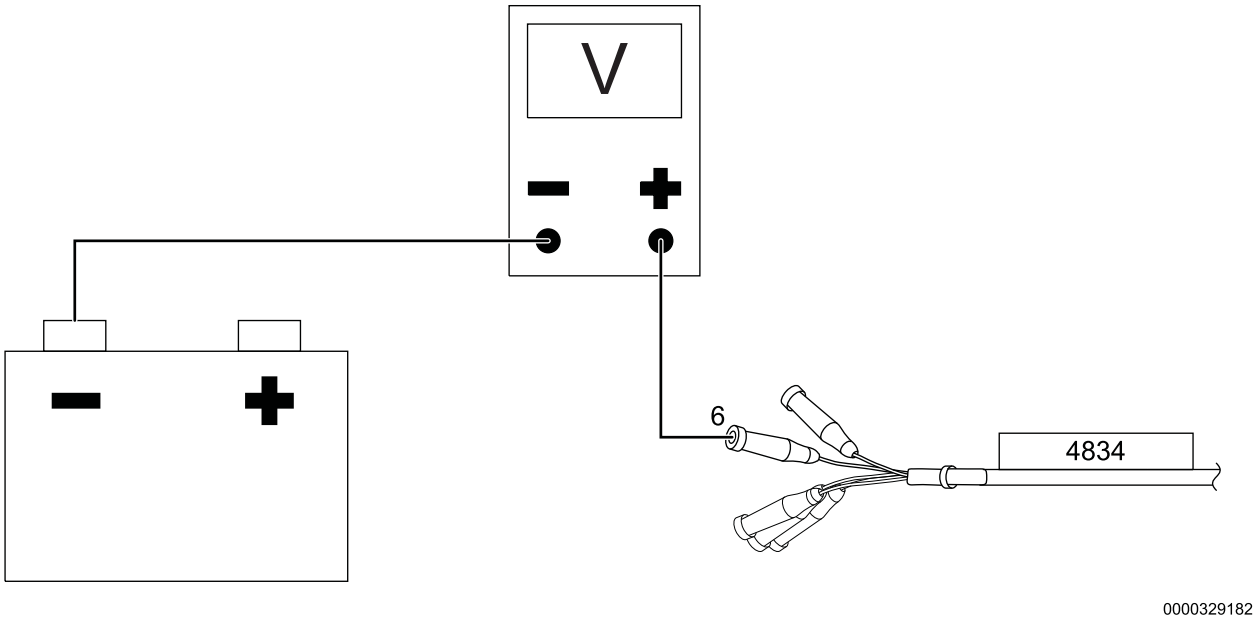


Figure 362 Test 2 Exhaust Back Pressure Valve (EBPV) connector Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure Valve (EBPV) connector. C. Connect Breakout Harness ZTSE4834 to vehicle harness and leave EBPV connector disconnected. D. Key ON.

Test 2	Specification
Using DMM measure voltage between Breakout Harness ZTSE4834 pin-6 and known good GND.	2.5 ± 0.5 volts
Decision	
Is voltage 2.5 ± 0.5 volts?	Yes: Replace EBPV assembly. After repairs are complete, retest for SPN 5543 FMI 5.
	No: Repair Open between EBPV pin-6 and Engine Control Module (ECM) pin E-56. After repairs are complete, retest for SPN 5543 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5543 FMI 5 fault code diagnostics.

ECB1 (Engine Compression Brake Output 1)

Overview of ECB1 Sensor Group

SPN	FMI	Condition
4287	0	ECB1 above desired level (page 973)
4287	1	ECB1 below desired level (page 975)
4287	3	ECB1 signal Out of Range HIGH (page 977)
4287	4	ECB1 signal Out of Range LOW (page 987)

Overview

Engine Compression Brake 1 (ECB1) is a compression release brake that works in conjunction with Injection Control Pressure (ICP) system to keep exhaust valves partially open during engine braking.

ECB1 sensor provides a feedback signal to Engine Control Module (ECM) indicating brake control pressure. ECM monitors ECB1 signal during engine normal and braking operation to determine if compression release brake system is working without fault.

SPN 4287 FMI 0 - ECBP above desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust valve actuation system oil pressure higher than expected	(Measured ECBP MINUS commanded ECBP> 4.5 MPa) OR (measured ECBP when commanded OFF > 1.041 MPa) for > 20 seconds	Key ON Engine Breaking Requested

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Brake Control Pressure (BCP) signal is greater than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 0, 1, 3, 4, 15, 16, 17, and 18 (ICP)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 4287 FMI 3 and 4 (ECBP)	• SPN 5543 FMI 3, 4, and 5 (EBPV)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Brake Control Pressure (BCP) sensor
- Failed Engine Compression Brake 1 (ECB1) valve
- Failed brake pressure relief valve
- Failed Injection Pressure Regulator (IPR) valve

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 973).		Yes: Repair Associated Faults. After repairs are complete, retest for SPN 4287 FMI 0.
Is EST DTC list free of Associated Faults?		No: Go to Step 2.

Step 2	Check Brake Control Pressure (BCP) sensor.	Decision
A. Key-On Engine-OFF (KOEO). B. Connect EST to Vehicle Diagnostic Connector (page 2124). C. Key ON. Log in to ServiceMaxx™ software. D. Using EST with ServiceMaxx™ software, monitor Brake Control Pressure (BCP).		Yes: Replace BCP sensor. After repairs are complete, retest for SPN 4287 FMI 0.
Is BCP greater than 145 psi (1.0 MPa)?		No: Go to Step 3.

Step 3	Check for leaking Engine Compression Brake (ECB1) valve assembly	Decision
A. Start Engine. B. Connect EST to vehicle Diagnostic Connector. (page 2124) C. Using EST with ServiceMaxx™ software, monitor BCP.		Yes: Replace ECB1 valve. After repairs are complete, retest for SPN 4287 FMI 0.
Is BCP greater than 145 psi (1.0 MPa) with engine running (engine compression brake never commanded on)?		No: Go to Step 4.

Step 4	Operate engine and test engine brake.	Decision
A. Using EST with ServiceMaxx™ software, record a snapshot recording of engine brake operation (brake commanded ON and brake commanded OFF). B. Activate engine brake.		Yes: Replace brake pressure relief valve. After repairs are complete, retest for SPN 4287 FMI 0.
Is BCP greater than 145 psi (1.0 MPa) AFTER the brake has been commanded off?		No: Go to Step 5.

Step 5	Operate engine and test engine brake.	Decision
A. Using EST with ServiceMaxx™ software, record a snapshot recording of engine brake operation (brake commanded ON and brake commanded OFF). B. Activate engine brake.		Yes: Replace Injection Pressure Regulator (IPR) valve. After repairs are complete, retest for SPN 4287 FMI 0.
Is BCP less than 653 psi (-4.5 MPa)?		No: Diagnostics complete.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4287 FMI 0 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 4287 FMI 1 - ECPB below desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Valve Actuation System Oil Pressure NOT plausible (Pressure lower than expected)	[Engine Injection Control pressure MINUS Measured Retarder pressure AND > 580.3 psi (4.001 MPa) for time] > 20 seconds	Key ON [Engine Brake Latched feature selected OR Engine Brake Coast feature selected OR Engine Brake with Cruise Control feature selected]

Fault Overview

Fault sets when engine Exhaust Valve Actuation System Oil Pressure is lower than expected. Injection control pressure minus measured retarder pressure is greater than 580.3 psi (4.001 MPa) for greater than 20 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 4287 FMI 3 and 4 (ECBP)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed ECBP

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 975). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4287 FMI 1.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4287 FMI 1. Is EST DTC list SPN 4287 FMI 1 active or pending?		Yes: Replace ECBP sensor. After repairs are complete, retest for SPN 4287 FMI 1. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4287 FMI 1 fault code diagnostics.

SPN 4287 FMI 3 - ECBP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Brake Control Pressure (BCP) sensor signal out of range high	BCP sensor signal voltage > 4.902 volts [> 5101 psi (35.2 MPa)]	Key ON (Engine brake latched feature selected OR engine brake coast feature selected OR engine brake with cruise control feature selected)

Fault Overview

Fault sets when Engine Control Module (ECM) senses Brake Control Pressure (BCP) sensor signal is out of range high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- BCP circuit Open
- BCP circuit short to PWR
- VREF1 circuit Open
- SIG GND circuit Open
- Failed UVC harness
- Failed BCP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 977). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4287 FMI 3.

Step 2	Inspect connections at Under Valve Cover (UVC) 1 connector.	Decision
A. Key OFF. B. Disconnect UVC1 sensor connector. C. Check UVC1 connector terminals for damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC1 connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4287 FMI 3.

Step 3	Inspect connections at Under Valve Cover (UVC) harness.	Decision
A. Key OFF. B. Remove Valve Cover. (See engine service manual) C. Check UVC connector terminals for damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC1 connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4287 FMI 3.

Step 4	Inspect connections at Under Valve Cover (UVC) harness.	Decision
A. Key OFF. B. Remove Valve Cover. (See engine service manual) C. Check BCP sensor connector terminals for damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are BCP sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4287 FMI 3.

Pin-Point Tests SPN 4287 FMI 3

BCP Circuit

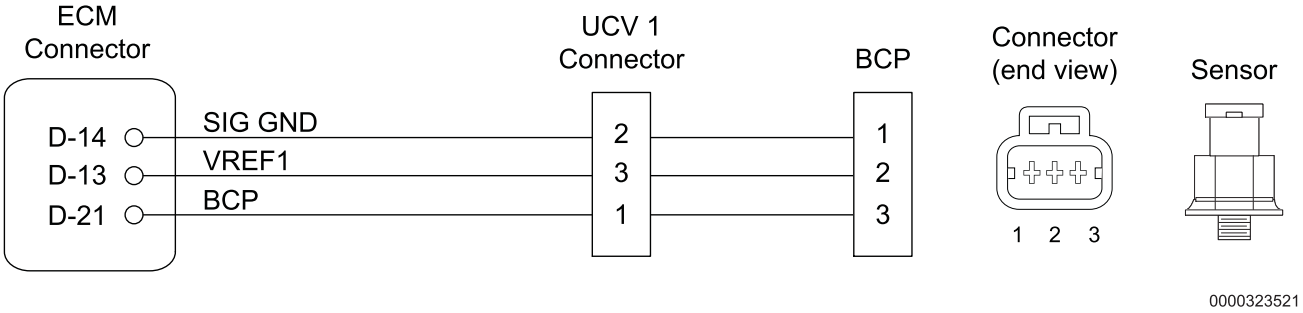


Figure 363 Brake Control Pressure (BCP) sensor circuit

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Tools Required

- Breakout Harness ZTSE4793
- Breakout Harness ZTSE4498
- Breakout Harness ZTSE4686
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

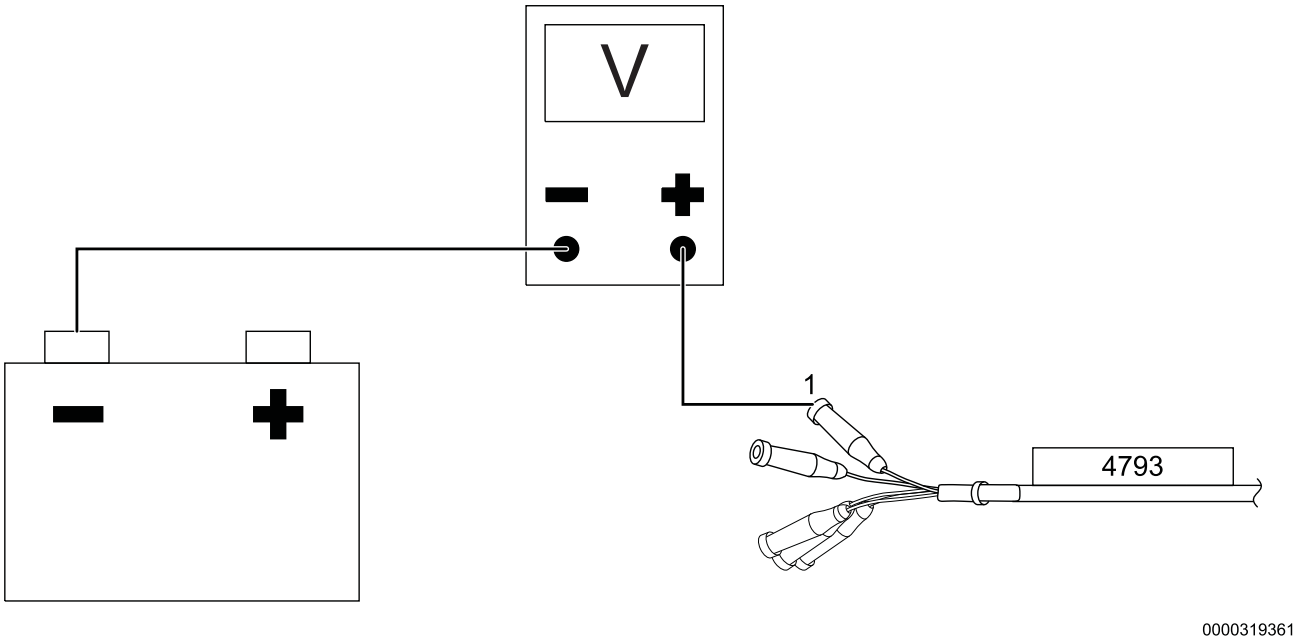


Figure 364 BCP circuit voltage check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector 1 (UVC1) connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC disconnected D. Key ON.

Test 1	Specification
Use a DMM to measure voltage between Breakout Harness ZTSE4793 pin-1 and a known good ground.	> 5 volts
Decision	
Is voltage greater than 5 volts?	Yes: Repair short to power between UVC1 pin-1 and Engine Control Module (ECM) pin D-21. After repairs are complete, retest for SPN 4287 FMI 3.
	No: Go to Test 2.

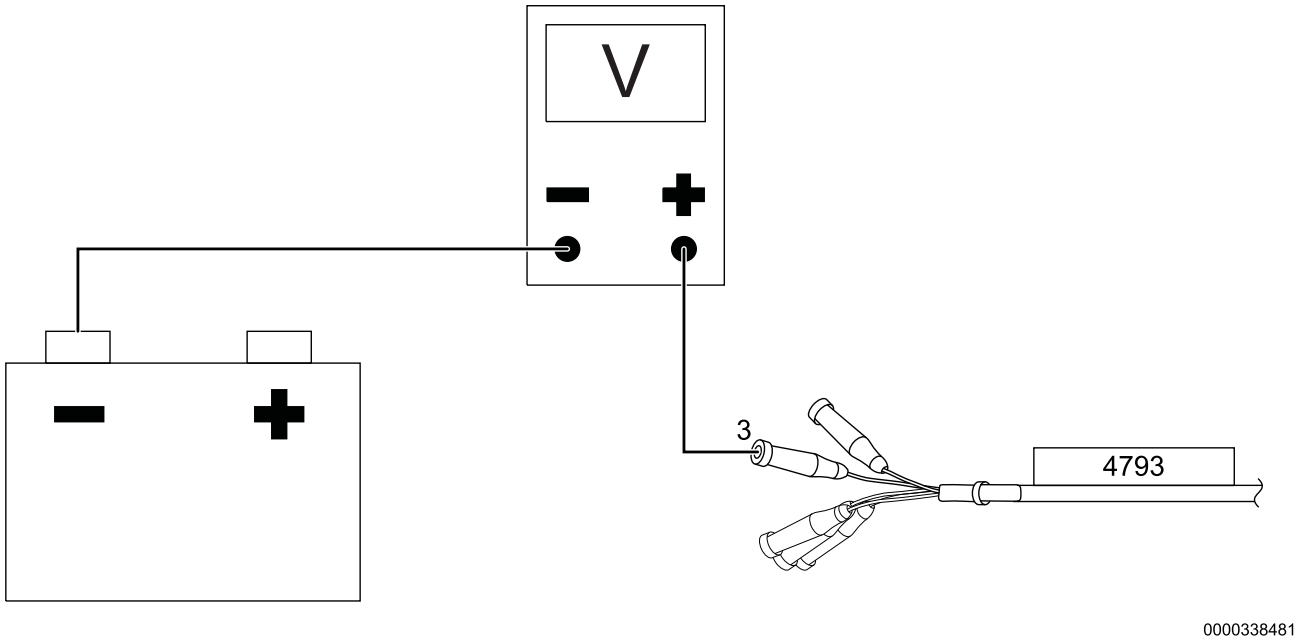
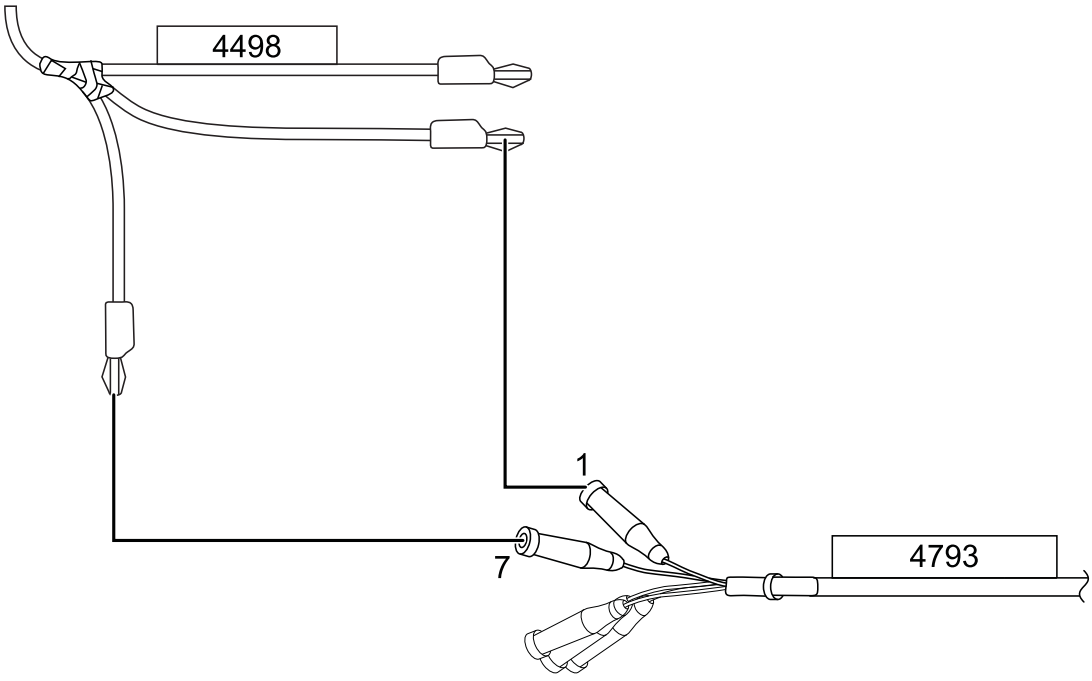


Figure 365 BCP Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect UVC1 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC disconnected D. Key ON.

Test 2	Specification
Use a DMM to measure voltage between Breakout Harness ZTSE4793 pin-3 and a known good ground.	5 volts ± 0.5 volts
Decision	
Is voltage 5 volts ± 0.5 volts?	Yes: Repair short to power between UVC1 pin-3 and Engine Control Module (ECM) pin D-13. After repairs are complete, retest for SPN 4287 FMI 3.
	No: Go to Test 3.



0000338501

Figure 366 BCP Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect UVC1 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC disconnected D. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4793 pin-1 to pin-7 E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 4287 FMI 4 sets in DTC list
Decision	
Does SPN 4287 FMI 4 set after DTC list is cleared?	Yes: Go to Step 3 (page 978).
	No: Go to Test 4.

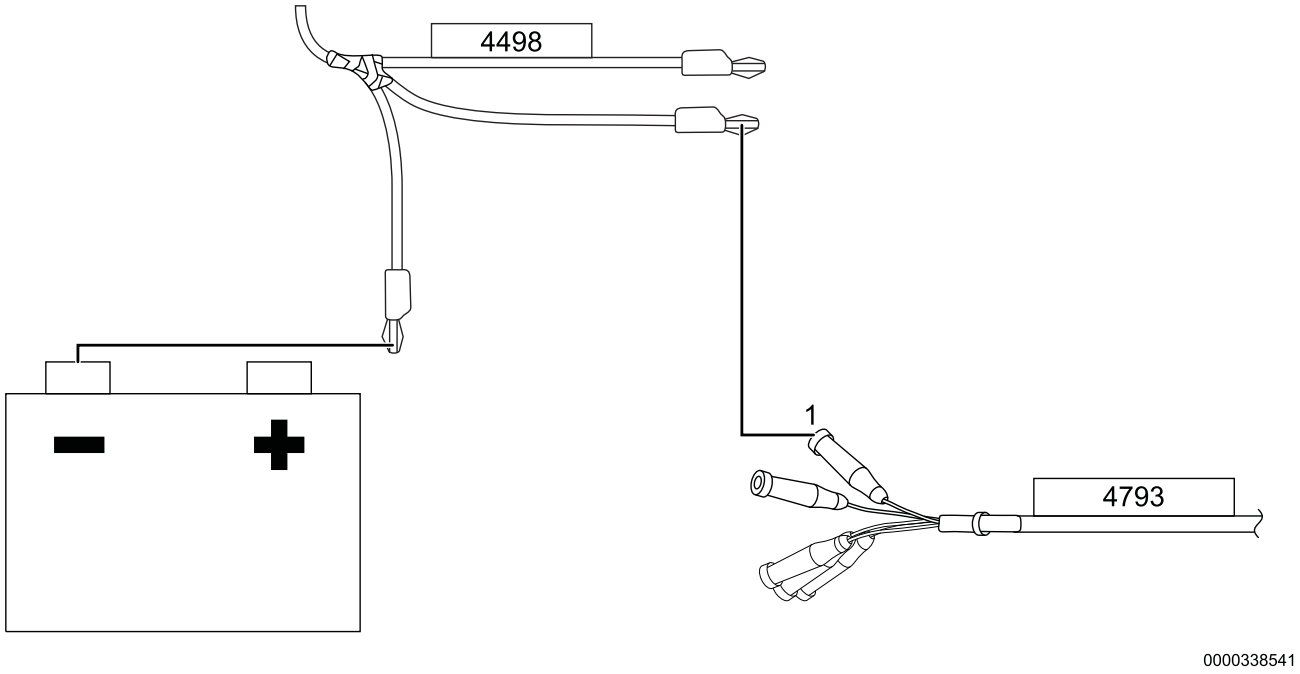
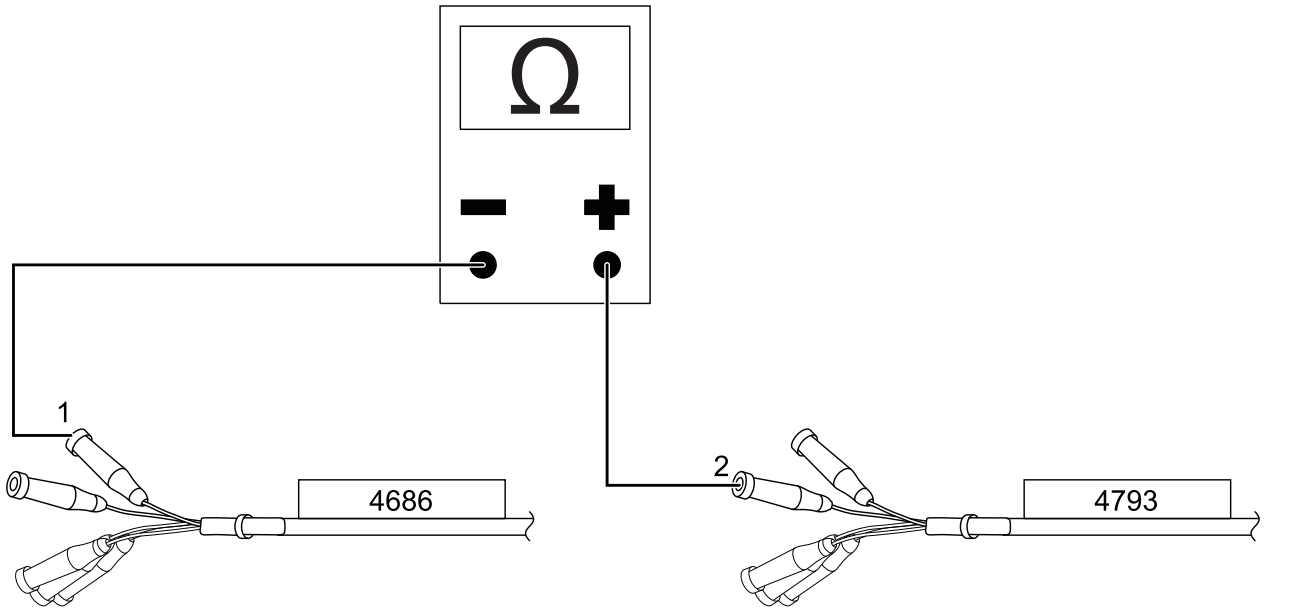


Figure 367 BCP Circuit Check

Test 4 Setup
A. Key OFF. B. Disconnect UVC1 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC disconnected D. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4793 pin-1 to a known good GND E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

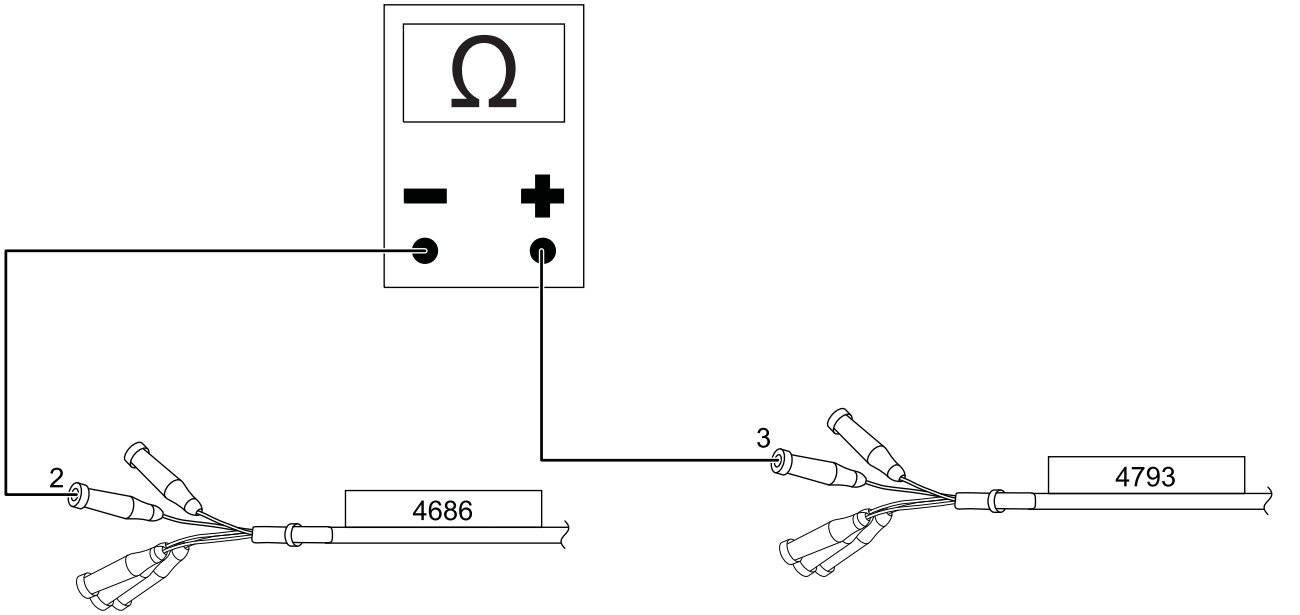
Test 4	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 4287 FMI 4 sets in DTC list
Decision	
Does SPN 4287 FMI 4 set after DTC list is cleared?	Yes: repair Open between UVC pin-2 and ECM pin D-14. After repairs are complete, retest for SPN 4287 FMI 3.
	No: repair Open between UVC pin-1 and ECM pin D-21. After repairs are complete, retest for SPN 4287 FMI 3.



0000338561

Test 5 Setup
A. Key OFF. B. Remove Valve Cover (see engine service manual) C. Disconnect UVC1 connector. D. Connect Breakout Harness ZTSE4793 to UVC connector and leave vehicle harness disconnected. E. Connect Breakout Harness ZTSE4686 to UVC harness and leave and BCP sensor disconnected.

Test 5	Specification
Use a DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and Breakout Harness ZTSE4686 pin-1	less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 7
	No: Repair Open between UVC1 pin-2 and BCP pin-1. After repairs are complete, retest for SPN 4287 FMI 3.



0000338581

Test 6 Setup
A. Key OFF. B. Remove Valve Cover (see engine service manual) C. Disconnect UVC1 connector. D. Connect Breakout Harness ZTSE4793 to UVC connector and leave vehicle harness disconnected. E. Connect Breakout Harness ZTSE4686 to UVC harness and leave and BCP sensor disconnected.

Test 6	Specification
Use a DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and Breakout Harness ZTSE4686 pin-2	less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 6
	No: Repair Open between UVC1 pin-3 and BCP pin-2. After repairs are complete, retest for SPN 4287 FMI 3.

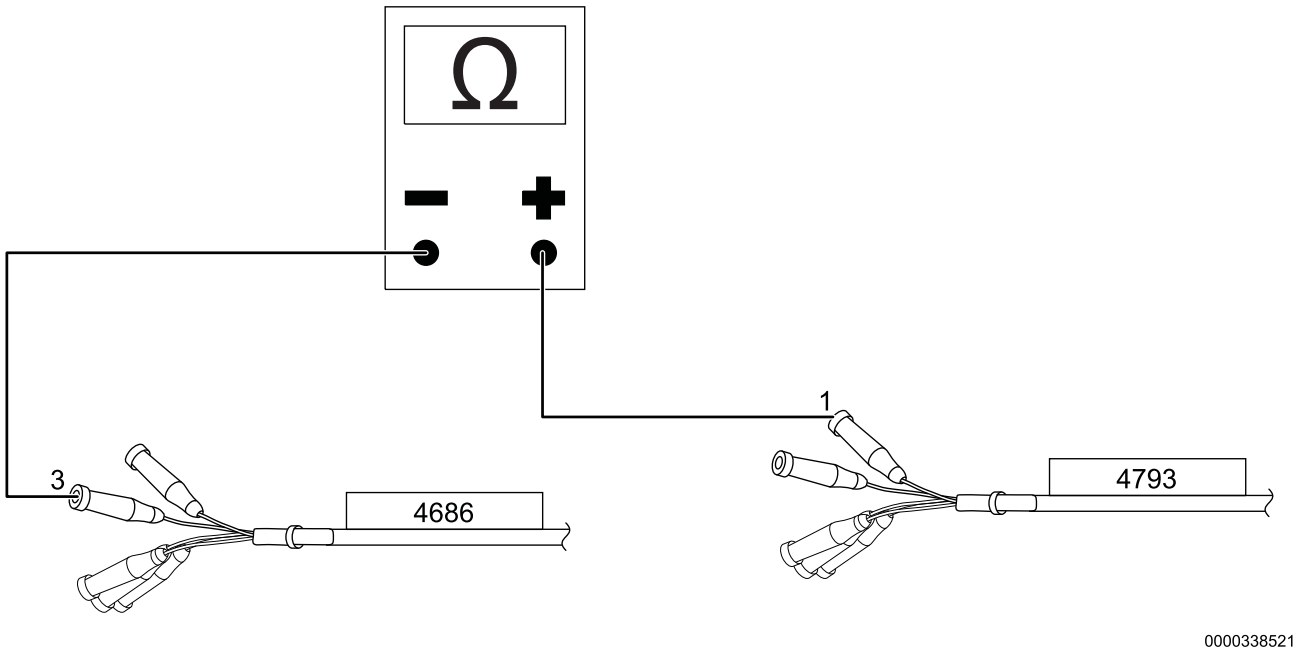


Figure 370 BCP Circuit Check

Test 7 Setup
A. Key OFF. B. Remove Valve Cover (see engine service manual) C. Disconnect UVC1 connector. D. Connect Breakout Harness ZTSE4793 to UVC connector and leave vehicle harness disconnected. E. Connect Breakout Harness ZTSE4686 to UVC harness and leave and BCP sensor disconnected.

Test 7	Specification
Use a DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and Breakout Harness ZTSE4686 pin-3	less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace BCP sensor. After repairs are complete, retest for SPN 4287 FMI 3.
	No: Repair Open between UVC1 pin-1 and BCP pin-3. After repairs are complete, retest for SPN 4287 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4287 FMI 3 fault code diagnostics.

SPN 4287 FMI 4 - ECBP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Brake Control Pressure (BCP) sensor signal Out of Range Low.	Exhaust valve actuation system oil pressure sensor signal voltage < 0.103 Volts	Key ON Engine braking requested

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Brake Control Pressure (BCP) sensor signal is out of range low.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Brake Control Pressure (BCP) circuit short to ground
- Failed BCP Sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 987). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4287 FMI 4.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4287 FMI 4.		Yes: Go to Step 3.
Is EST DTC list SPN 4287 FMI 4 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect Under Valve Cover (UVC) connector.	Decision
A. Key OFF. B. Disconnect UVC connector. C. Check UVC connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4287 FMI 4.

Pin-Point Tests (SPN 4287 FMI 4)

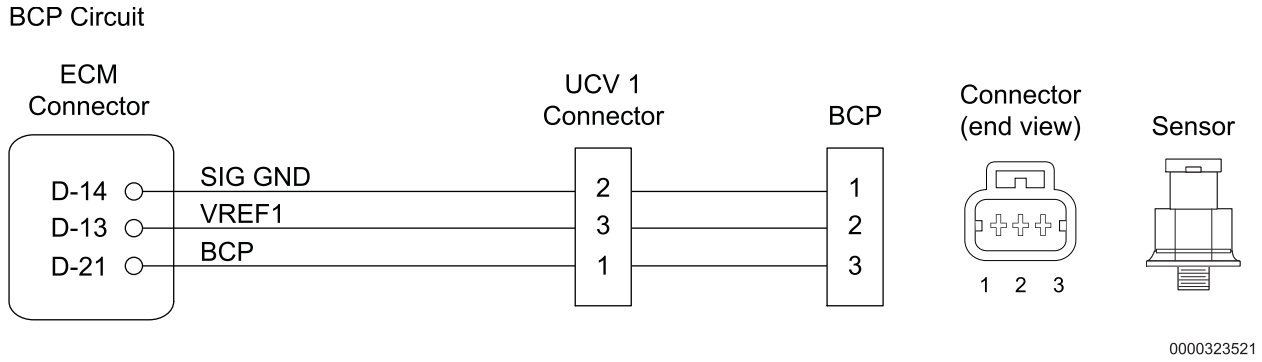


Figure 371 BCP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Cover (UVC) connector 1. C. Connect Breakout harness ZTSE4793 to vehicle harness and leave UVC connector disconnected. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 1	
Clear codes, check Diagnostic Trouble Code (DTC) list for SPN 4287 FMI 4.	
Decision	
Is SPN 4287 FMI 4 still active?	Yes: Repair short to ground between UVC pin-1 and Engine Control Module (ECM) pin D-21. After repairs are complete, retest for SPN 4287 FMI 4.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Cover (UVC) connector 1. C. Connect Breakout harness ZTSE4793 to vehicle harness and leave UVC connector disconnected.

Test 2	
Use DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	
Decision	
Is resistance greater than 1000 ohms?	Yes: Replace Brake Control Pressure (BCP) sensor. After repairs are complete, retest for SPN 4287 FMI 4.
	No: Repair short to short to ground between UVC pin-1 and BCP pin-3. After repairs are complete, retest for SPN 4287 FMI 4.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4287 FMI 4 fault code diagnostics.

ECI Circuit (Engine Crank Inhibit)

Overview of ECI Circuit

SPN	FMI	Condition
None		Engine starter motor will not engage

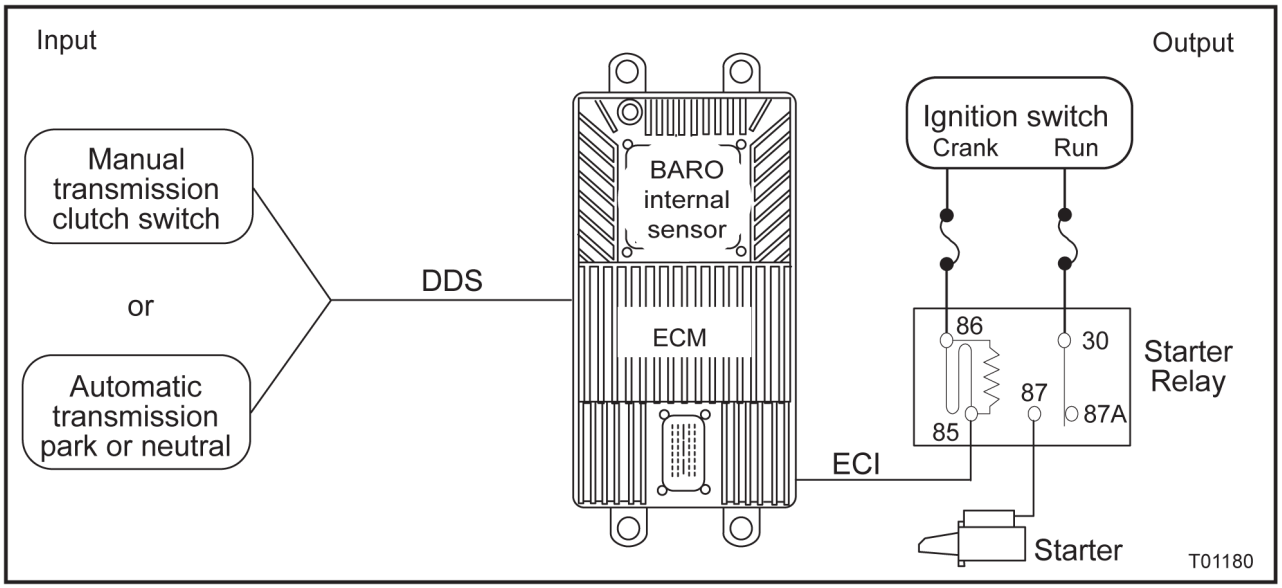


Figure 372 Engine Crank Inhibit (ECI) Function Diagram

Function diagram for Engine Crank Inhibit (ECI) circuit consists of the following:

- Engine Control Module (ECM) with Barometric Absolute Pressure (BARO) Internal Sensor
- Starter
- Starter Relay
- ECI Circuit
- Drive line Disengagement Switch (DDS)

Function

Engine Crank Inhibit (ECI) circuit is controlled by ECM. It prevents starter engagement while engine is running (above a set calibrated rpm). Starter engagement is also prevented when automatic transmission is in gear or manual transmission clutch pedal is not depressed. Starter relay can also be disabled by an optional over crank thermocouple.

Location

Relay and switches are vehicle-mounted parts. For additional supporting information, see truck *Chassis Electrical Circuit Diagram Manual* and *Electrical System Troubleshooting Guide*.

Tools

- Digital Multimeter (DMM)

- 00-00956-08 – 180-pin Breakout Box
- Breakout Harness 4674 (ECM)

ECI Circuit Diagnostics

SPN	FMI	Condition	Possible Causes
None		Engine starter motor will not engage	• Transmission in gear • Clutch pedal not depressed • No PWR to automatic transmission module • No PWR to ECM • Blown fuse • Failed starter relay • OPEN DDS circuit • OPEN ECI circuit • Failed Ignition Switch (VIGN) • Failed starter motor

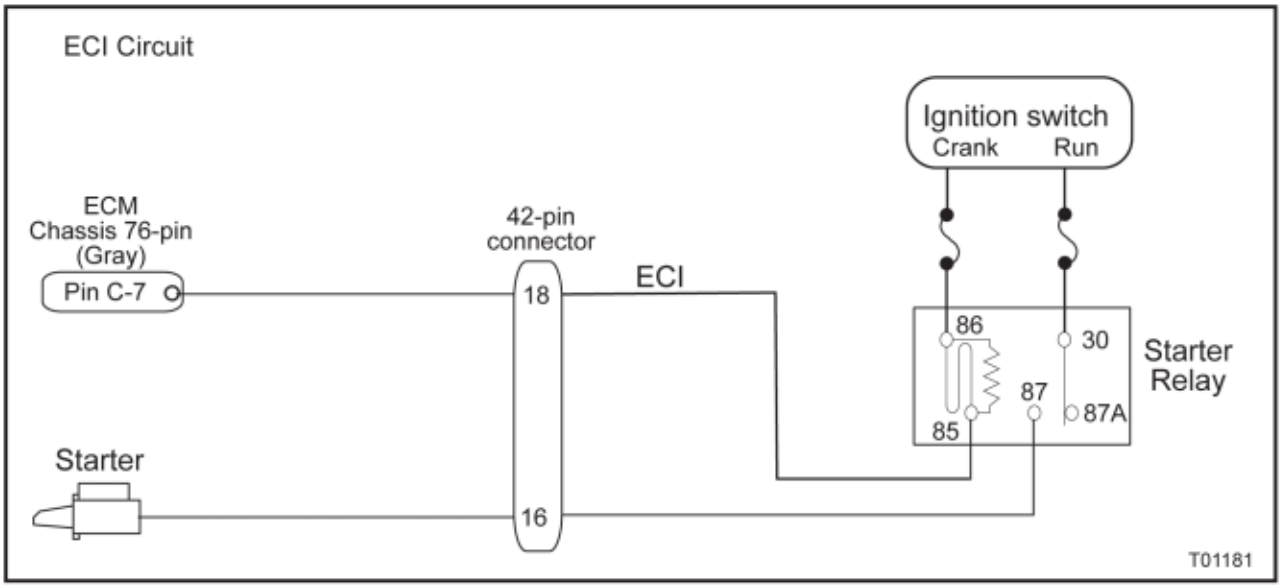


Figure 373 ECI circuit diagram

For additional circuit information see truck *Chassis Electrical Circuit Diagram Manual* and *Electrical System Troubleshooting Guide*.

Voltage Check at Relay

Connect Breakout Harness 4674 between relay and relay socket. Turn ignition switch to ON. Use DMM to measure voltage.

Test Point	Specification	Comment: < Less than, > Greater than
30 to GND	B+	If < B+, check power circuit to relay switch for OPEN or short to GND, or blown fuse.
Use DMM to measure voltage while cranking engine.		
86 to GND	B+	If < B+, check PWR circuit to relay coil for OPEN or short to GND, blown fuse, or possible failed ignition switch. For additional circuit information, see truck *Chassis Electrical Circuit Diagram Manual* and *Electrical System Troubleshooting Guide*.
85 to GND	< 2 V	If B+, check ECI control circuit for OPEN or failed thermal over-crank protection switch. If 4 to 5 volts, check DDS circuit to ECM, and go to Voltage Check at ECM (page 996).
87 to GND	B+	If < B+, replace relay. If B+, check voltage at starter.

Voltage Check at ECM

Connect 180-pin Breakout Box between ECM and chassis harness. Turn ignition switch to ON. Use DMM to measure voltage.

Test Point	Specification	Comment: < Less than, > Greater than
C-31 to GND	B+	If < B+, check VIGN circuit for OPEN or short to GND, blown fuse, or possible failed ignition switch.
C-2 to GND C-4 to GND C-6 to GND	0 V	If voltage is present, check for OPEN ECM GND circuit. Go to ECM PWR in this section of manual.
C-1 to GND C-3 to GND C-5 to GND	B+	If < B+, check for OPEN ECM PWR circuit. Go to ECM PWR in this section of manual.
Place automatic transmission in park or neutral (manual transmission, depress clutch). Use DMM to measure voltage.		
C-65 to GND	B+	If < B+, check DDS for OPEN circuit. • For automatic transmission, see transmission diagnostics. • For manual transmission, check PWR circuit to clutch pedal or blown fuse. A failed clutch pedal switch is possible.
C-7 to GND	< 2 V	If > 2 volts, check ECM programming.

Harness Resistance Check – ECM to Relay

Turn ignition switch to OFF. Disconnect ECM. Leave relay disconnected. Connect 180-pin Breakout Box and relay harness. Use DMM to measure resistance.

Test Point	Specification	Comment: < Less than, > Greater than
85 to C-7	< 5 Ω	If > 5 Ω, check ECI control circuit for OPEN or possible failed thermal over-crank protection switch.
85 to GND	> 1 kΩ	If < 1 kΩ, check ECI control for short to GND.
87 to starter	< 5 Ω	If > 5 Ω, check ECI control for OPEN or possible failed thermal over-crank protection switch.
87 to GND	> 1 kΩ	If < 1 kΩ, check circuit for short to GND.

Operational Voltage Check

Connect 180-pin Breakout Box between ECM and chassis harness. Turn ignition switch to ON. Use DMM to measure voltage.

Test Point	Specification	Condition
DDS C-65 to GND	B+	ECM Input – Clutch pedal not depressed or automatic transmission in gear. Cranking is disabled.
	0 V	ECM Input – Clutch pedal to the floor or automatic transmission in park or neutral. Cranking is enabled.
Use DMM to measure voltage while cranking engine.		
ECI C-7 to PWR	0 V	ECM Control – Engine Crank Inhibit enabled.
	B+	ECM Control – Engine Crank Inhibit disabled.

Harness Resistance Check – Relay to Battery

WARNING: To prevent personal injury or death, always disconnect main negative battery cable first. Always connect the main negative battery cable last.

Disconnect both battery GND cables. Disconnect ECI relay and VIGN. Use DMM to measure resistance.

86 to VIGN	< 5 Ω	If > 5 Ω, check circuit for OPEN.
86 to GND	> 1 kΩ	If < 1 kΩ, check for short to GND.
30 to B+ battery post	< 5 Ω	If > 5 Ω, check circuit for OPEN or blown fuse.
30 to GND	> 1 kΩ	If < 1 kΩ, check for short to GND.
C-65 DDS circuit	See vehicle electrical diagrams. Check for OPEN or short to GND. Possible failed clutch switch or automatic transmission module circuit faults.	

ECI Circuit Operation

Engine Control Module (ECM) controls starting system. Clutch switch or transmission neutral switch provides input to ECM. Both switches prevent starter from being engaged unless automatic transmission is in park or neutral, or manual transmission clutch is depressed.

DDS Circuit

ECM monitors DDS on Pin C-65. B+ indicates drivetrain is disengaged and engine is ready to start. Zero volts indicates drivetrain is engaged and engine is not ready to start. Source of this signal depends on vehicle's hardware configuration. See appropriate electrical diagrams when diagnosing this circuit.

Ignition Switch

VIGN is supplied to starter relay coil (Pin 86) when engine is cranked.

ECI Circuit

ECM controls starter disable with ECI circuit, pin C-7 to starter relay coil Pin 85. Open or B+ will disable relay. A 0-volt (GND) will enable relay.

Engine Control Module (ECM)

When ECM recognizes that engine is not running and drive line is not engaged, ECM will ground Pin C-7. This provides a current path for ECI relay to close when Start switch is engaged or starter button is depressed. When ECM recognizes that engine is running or drive line is engaged, ECM will open Pin C-7. This prevents ECI relay from closing and starter motor from engaging.

Starter Relay

Engine starter relay controls voltage to starter motor. Turning ignition switch to start position supplies current to energize starter relay at Pin 86. If engine is not running and drive line is not engaged, ECM Pin C-7 will enable relay by supplying a ground to Pin 85 of relay. When relay is closed, current passes through relay to starter solenoid.

Clutch Switch

Manual transmissions use clutch switch to supply a signal to ECM indicating drive line is disengaged. A 12-volt signal on DDS circuit indicates clutch is disengaged. A 0-volt signal indicates clutch is engaged.

Neutral Switch

Allison LCT transmissions use neutral position switch to supply power to starter relay and a signal to ECM that drive line is disengaged. Vehicles programmed for Allison AT / MT transmissions receive a 12-volt signal on DDS circuit indicating transmission is out of gear. A 0-volt signal indicates transmission is in gear. When transmission is in gear, no power is available to starter relay.

WTEC MD with Auto Neutral

Allison MD World Transmission Electronically Controlled (WTEC) transmissions (with optional Auto Neutral) have a crank inhibit system with an additional relay. Relay inhibits cranking when transmission is in auto neutral. Pin 6 of transmission module controls 12-volt signal to Pin 86 of starter relay. Pin C-65 of ECM receives 12-volt from WTEC auto neutral relay when transmission is shifted to neutral or auto neutral.

Fault Detection / Management

There are no codes associated with ECI system.

ECM (Engine Control Module)

Overview of ECM Sensor

SPN	FMI	Description
108	2	BARO signal erratic, intermittent, or incorrect (page 1001)
108	3	BARO signal Out of Range HIGH (page 1003)
108	4	BARO signal Out of Range LOW (page 1005)
158	15	Battery Voltage above 16 volts (page 1007)
158	17	Battery Voltage below 9 volts (page 1009)
628	12	ECM Memory Error (page 1019)
629	0	ECM Error - CPU Load Excessively HIGH (page 1021)
629	8	ECM Error - Engine Off Timer fault (page 1023)
629	12	ECM Internal chip Error (page 1026)
1136	0	ECM Error - over temperature (page 1028)
1387	31	Altitude Reference Adder Fault (page 1030)

Overview

Engine Control Module (ECM) requires battery power to operate Body Controller (BC) and perform maintenance after ignition switch is turned off. To do this, ECM must control its own power supply. When ECM receives Ignition (VIGN) signal from ignition switch, ECM will enable relay to power-up. When ignition switch is turned off, ECM performs internal maintenance, then disables ECM relay.

SPN 108 FMI 2 - BARO Signal Erratic, Intermittent or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Barometric Absolute Pressure (BARO) signal erratic, intermittent, or incorrect	BARO reading at Key-On is more than 4.35 psi (30 kPa) different than the EBP and IMP sensor readings.	Initial Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Barometric Absolute Pressure (BARO) sensor signal is erratic intermittent or incorrect

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

BARO sensor is located inside Engine Control Module (ECM). If there is a confirmed BARO failure, ECM must be replaced.

Drive Cycles

Continuous

Possible Cause

- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 108 FMI 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 108 FMI 2. Is EST DTC list SPN 108 FMI 2 active or pending?		Yes: Replace Engine Control Module (ECM)), following approved warranty procedures. After repairs are complete, retest for SPN 108 FMI 2. No: Diagnostics complete.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 108 FMI 2 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 108 FMI 3 - BARO signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Barometric Pressure (BARO) Sensor signal Out of Range High	BARO sensor voltage > 4.68 Volts - 16.6 psi (114.5 kPa)	Key ON

Fault Overview

Fault Code sets when Barometric Pressure (BARO) sensor is above maximum threshold.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

The BARO sensor is installed inside Engine Control Module (ECM).

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 108 FMI 3.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 108 FMI 3. Is EST DTC list SPN 108 FMI 3 active or pending?		Yes: Replace Engine Control Module (ECM)), following approved warranty procedures. After repairs are complete, retest for SPN 108 FMI 3. No. Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 108 FMI 3 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 108 FMI 4 - BARO signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Barometric Pressure (BARO) Sensor signal Out of Range Low	BARO sensor voltage < 0.45 Volts - 2.9 psi (20.55 kPa)	Key ON

Fault Overview

Determines if Barometric Pressure (BARO) sensor is below minimum threshold.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

The BARO sensor is installed inside Engine Control Module (ECM).

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 108 FMI 4.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 108 FMI 4. Is EST DTC list SPN 108 FMI 4 active or pending?		Yes: Replace Engine Control Module (ECM)), following approved warranty procedures. After repairs are complete, retest for SPN 108 FMI 4. No. Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 108 FMI 4 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 158 FMI 15 - Battery Voltage above 16 volts

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Control Module (ECM)Switched voltage too HIGH	Battery Voltage > 16 Volts	Key ON Time after Engine start > 10 seconds Intake Air heater has been turned "OFF" for > 10 seconds

Fault Overview

Fault sets when Engine Control Module (ECM) Switched voltage is too High.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

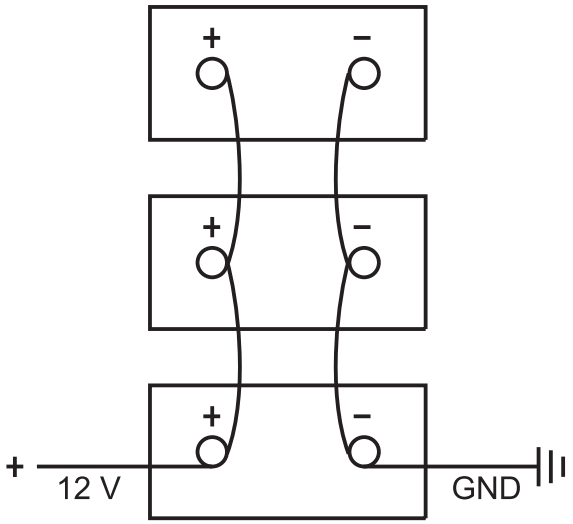
None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Charging voltage excessive
- Incorrect battery pack wiring (series instead of parallel)



0000053798

Figure 374 Approved Battery Cable Sequence

Step 1	Check for correct parallel battery pack wiring.	Decision
Positive battery cable(s) should be connected from positive battery terminal to positive battery terminal. Negative battery cable(s) should be connected from negative battery terminal to negative battery terminal. Is battery pack correctly assembled (wired in parallel and Not in series)?		Yes: Go to step 2. No: Reassemble battery pack. After repairs are complete, retest for SPN 158 FMI 15.

Step 2	Check for correct battery voltage Key-On Engine-Running (KOER).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. KOER, monitor battery voltage. Is battery voltage greater than 16 volts?		Yes: Replace alternator. After repairs are complete, retest for SPN 158 FMI 15. No: Check for incorrect battery charger selection. After repairs are complete, retest for SPN 158 FMI 15.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 158 FMI 15 fault code diagnostics.

SPN 158 FMI 17 - Battery Voltage below 9 volts

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Control Module Switched voltage too Low	Battery Voltage < 9 Volts	Key ON Time after Engine start > 10 seconds Intake Air Heater (IAH) has been turned "OFF" for > 10 seconds

Fault Overview

Fault sets when Engine Control Module (ECM) switched voltage is to low with battery voltage within normal operating range.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low battery or charging system voltage
- Failed ECM PWR Relay
- ECM PWR circuit high resistance
- GND circuit high resistance

Step 1	Inspect battery connections and terminals.	Decision
A. Key OFF. B. Disconnect battery connections. C. Check battery connections and terminals for damage; wet or corroded terminals; loose, bent, or broken connections; or broken connector housing.		Yes: Go to Step 2.
Are battery connectors, harnesses, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 158 FMI 17.

Step 2	Sensor and connector inspection	Decision
A. Key OFF. B. Disconnect ECM PWR relay. C. Check ECM PWR relay and relay terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are ECM PWR relay connectors, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 158 FMI 17.

Step 3	Check battery charge voltage.	Decision
Perform Test 1(page 1013). Using DMM measure voltage between Battery PWR and Battery GND.		Yes: Go to Step 4.
Is voltage 12 ± 0.5 volts?		No: Charge batteries and check charging voltage. After repairs are complete, retest for SPN 158 FMI 17.

Step 4	Check ECM PWR relay circuit voltage	Decision
Perform Test 2(page 1014). Using DMM measure voltage between Breakout Harness ZTSE4674 pin-87 and known good GND.		Yes: Go to Step 8.
Is voltage B+ ± 0.5 volts?		No: Go to Test 5.

Step 5	Check ECM PWR relay voltage.	Decision
Perform Test 3(page 1015). Using DMM measure voltage between Breakout Harness ZTSE4674 pin-30 and known good GND.		Yes: Replace ECM PWR Relay. After repairs are complete, retest for SPN 158 FMI 17.
Is voltage B+ ± 0.5 volts?		No: Go to Step 6.

Step 6	Check ECM PWR relay high resistance.	Decision
Perform Test 4(page 1016). Using DMM measure voltage between 9261 pin-A and known good GND. Is voltage B+ ± 0.5 volts?		Yes: Go to Step 7. No: Repair high resistance between ECM PWR circuit between ECM PWR Relay pin-30 and 9261 pin-A. After repairs are complete, retest for SPN 158 FMI 17.

Step 7	Check ECM PWR relay high resistance.	Decision
Perform Test 5(page 1017). Using DMM measure voltage between B+ Junction Block and known good GND. Is voltage B+ ± 0.5 volts?		Yes: Repair high resistance between ECM PWR relay pin-87 and ECM pin C-1, 3, and 5. After repairs are complete, retest for SPN 158 FMI 17. No: Repair high resistance between ECM circuit between 9261 pin-A and B+. After repairs are complete, retest for SPN 158 FMI 17.

Step 8	Check ECM PWR relay high resistance.	Decision
Perform Test 6(page 1018). Using DMM measure voltage between 9260 pin-A and B+. Is voltage B+ ± 0.5 volts?		Yes: Repair high resistance between 9260 and ECM pin C-2, 4, and 6. After repairs are complete, retest for SPN 158 FMI 17. No: Repair high resistance between pin-A and GND. After repairs are complete, retest for SPN 158 FMI 17.

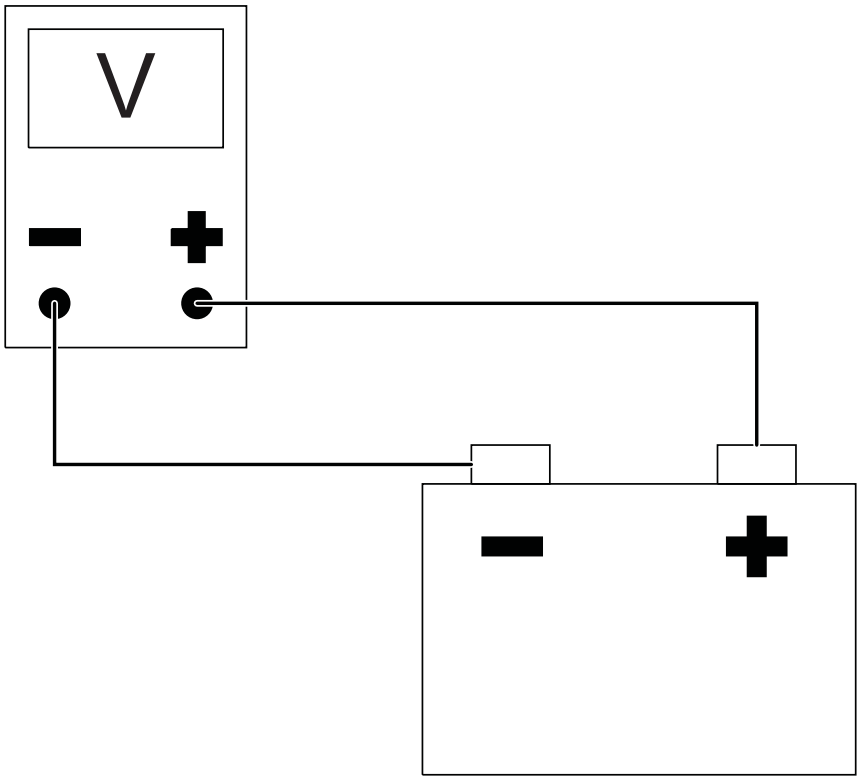
End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 158 FMI 17 fault code diagnostics.

Pin-Point Tests (SPN 158 FMI 17)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4674
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM)



0000330601

Figure 375 Test 1 Battery Voltage Check

Test 1
A. Key OFF.
B. Disconnect battery negative cable, and then positive cable.
C. Measurements will be made with key OFF.

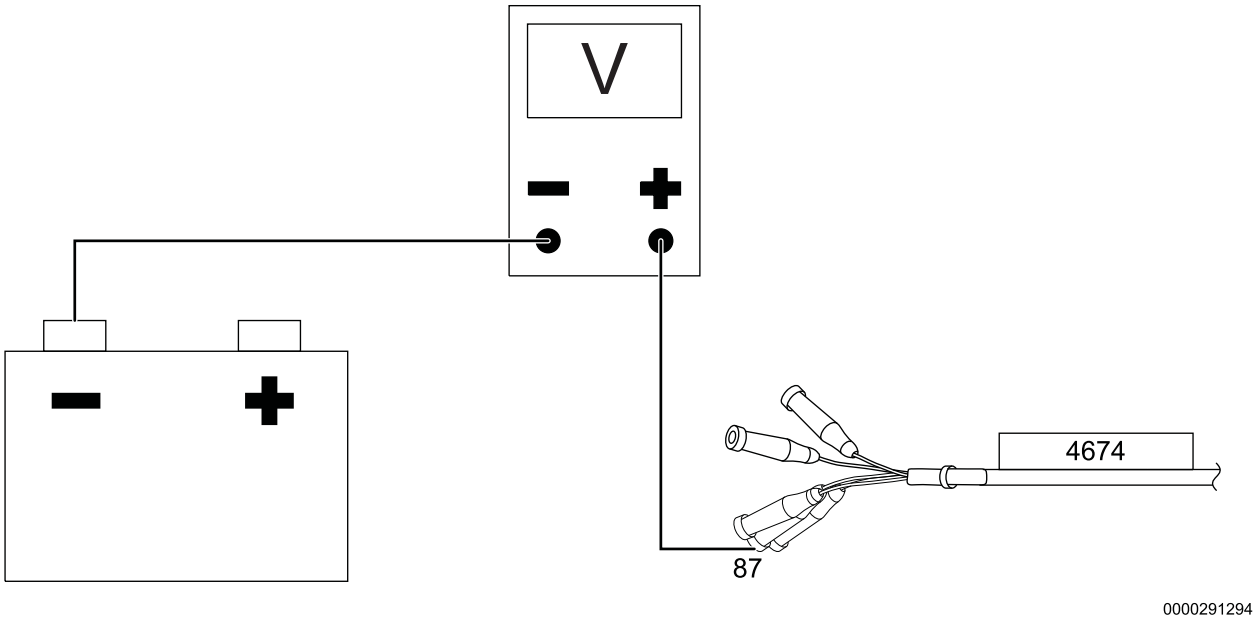


Figure 376 Test 2 ECM PWR relay Circuit Voltage Check

Test 2
A. Key OFF.
B. Disconnect ECM PWR relay connector.
C. Connect Breakout Harness ZTSE4674 to vehicle harness and leave ECM PWR relay connector disconnected.
D. Key ON.

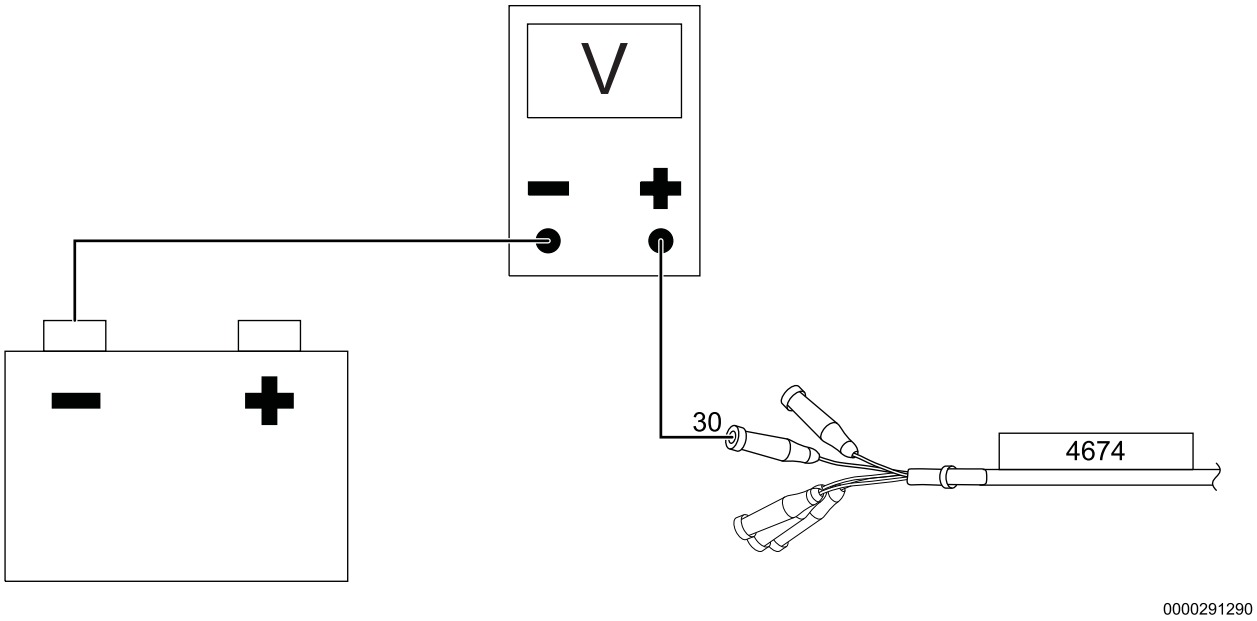


Figure 377 Test 3 ECM PWR relay Circuit Voltage Check

Test 3
A. Key OFF. B. Disconnect ECM PWR relay connector. C. Connect Breakout Harness ZTSE4674 to vehicle harness and leave ECM PWR relay connector disconnected.

Test 4
A. Key OFF. B. Disconnect 9261 connector. C. Connect applicable tool from International® Electronic Engine Terminal Test Kit ZTSE4435C to vehicle harness and leave 9261 connector disconnected.

Test 5
A. Key OFF. B. Connect DMM between positive battery post and known good GND.

Test 6
A. Key OFF. B. Disconnect 9260 connector. C. Connect applicable tool from International® Electronic Engine Terminal Test Kit ZTSE4435C to vehicle harness and leave 9260 connector disconnected.

SPN 628 FMI 12 - ECM Memory Error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Control Module (ECM) Error - A/D conversion monitoring	Internal ECM Fault	Key ON

Fault Overview

Fault code sets when the Engine Control Module (ECM) detects an internal memory error within the ECM.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 628 FMI 12.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 628 FMI 12. Is SPN 628 FMI 12 set after DTC list is cleared?		Yes: Replace Engine Control Module (ECM), following approved warranty procedures. After repairs are complete, retest for SPN 628 FMI 12. No: Release vehicle to customer.

End Diagnostic Step
After performing diagnostic step, if SPN 628 FMI 12 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 629 FMI 0 - ECM Error - CPU Load Excessively HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Control Module (ECM) Central Processing Unit (CPU) load excessively high detected.	ECM CPU load is excessively high	Key ON

Fault Overview

Fault Code sets when the ECM detects CPU load is excessively high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Clear codes, reset ECM, see if fault returns.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Defective ECM or software.

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 629 FMI 0.

Step 2	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, clear fault code. Run drive cycle and check for fault code SPN 629 FMI 0 in DTC list. Did fault code set?		Yes: Replace Engine Control Module (ECM), following approved warranty procedures. After repairs are complete, retest for SPN 629 FMI 0. No: Go to Step 3.

Step 3	Reprogram ECM.	Decision
Using EST with ServiceMaxx™, clear fault code. Run drive cycle and check for fault code SPN 629 FMI 0 in DTC list. Did fault code set?		Yes: Reprogram ECM. After repairs are complete, retest for SPN 629 FMI 0. No: Release vehicle to customer.

End Diagnostic Step
After performing diagnostic step, if SPN 629 FMI 0 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 629 FMI 8 - ECM Error - Engine Off Timer fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine OFF timer is not reading as expected.	Engine Control Module (ECM) communicates any of following has occurred: A. PIC timer is stopped B. PIC time is invalid C. PIC chip error status detected D. PIC chip has no power Absolute difference of engine OFF timer count and ECM timer count > 5% Engine OFF timer value lower than ECM power down time at previous ECM power cycle	Key ON Key-On Engine-Running (KOER) Sum of engine run time and engine OFF timer < 86,340 seconds PIC (engine OFF timer) chip is running Time after Key ON > 30 seconds PIC timer not stopped No battery faults on PIC timer No PIC timer error Engine OFF timer value < 86,340 seconds

Fault Overview

Fault code sets when Engine Control Module (ECM) detects engine OFF timer is not reading as expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

ECM Timer Fuse may be an in-line fuse in the engine compartment, see *Truck Wiring Diagram* for more information.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuse for engine-off timer
- Circuit fault for engine-off timer

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 629 FMI 8.		Yes: Go to Step 2.
Does EST DTC list show SPN 629 FMI 8 as Active or Pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Check for active fault code after Engine Control Module (ECM) reset.	Decision
A. Using EST with ServiceMaxx™ software, clear DTC list. B. Key OFF. Allow ECM to power down. C. Key ON.		Yes: Go to Step 3.
Does EST DTC list free show SPN 629 FMI 8 as Active or Pending?		No: Repair is complete.

Step 3	Check ECM timer fuse.	Decision
A. Key OFF. B. Disconnect ECM timer fuse holder harness connector. C. Check ECM timer fuse holder connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. D. Check ECM timer fuse.		Yes: Go to Step 4
Are ECM timer fuse holder connector, harness and terminals clean and undamaged?		No: Repair connector, connector, harness, or terminal damage. After repairs are complete, retest for SPN 629 FMI 8

Step 4	Check for blown ECM timer fuse.	Decision
Inspect ECM timer fuse.		Yes: Replace ECM timer fuse and repair short to GND between ECM pin C-46 and ECM timer fuse. After repairs are complete, clear fault code and retest for SPN 629 FMI 8.
Is ECM timer fuse burned out?		No: Go to Step 5.

Step 5	Check voltage at terminal block for ECM timer fuse.	Decision
Measure voltage between fuse terminal block (9261 side) and known good ground.		Yes: Repair Open circuit between terminal block and ECM terminal C-46. After repairs are complete, retest for SPN 629 FMI 8.
Is B+ voltage present at ECM timer fuse?		No: Repair Open between terminal block and truck wiring harness. After repairs are complete, retest for SPN 629 FMI 8.

End Diagnostic Steps
After performing diagnostic steps, if SPN 629 FMI 8 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 629 FMI 12 - ECM Internal chip Error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of Actual vs. Estimated engine speed Error of Engine Control Module's Non Volatile Memory (NVRAM write error) Engine Control Module Self Test for Hardware Error Processor Monitoring	Absolute Value of {Actual Engine Speed MINUS Engine Speed calculated from a Software Timer (n_32_sub_mon)} / {Actual Engine Speed} > 0.101 (ratio) Engine Control Unit indicates a Hardware error in Non Volatile Memory Hardware Error in the ATIC_35 Chip detected Hardware Error in the ATIC_39 Chip detected This error is set in if one of the following is true: 1. Error in Engine Control Module Self Test 2. RAM Error in the Micro Controller 3. ROM Error in the Micro Controller 4. Pendrive check error	Key ON Called by Processor Monitoring as a subroutine on demand

Fault Overview

Fault code sets when Engine Control Module (ECM) detects an internal chip error within ECM.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Clear faults, reset ECM, see if faults remain cleared

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 629 FMI 12.

Step 2	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™, clear fault code. Run drive cycle and use EST with ServiceMaxx™ to check DTC list for fault code. Does code set?		Yes: Replace Engine Control Module (ECM), following approved warranty procedures. After repairs are completed, retest for SPN 629 FMI 12. No: Diagnostics complete.

End Diagnostic Step
After performing diagnostic step, if SPN 629 FMI 12 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 1136 FMI 0 - ECM Error - over temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
ECM Error - over temperature	ECM temperature greater than expected	Key ON

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

- External heat source
- Failed ECM

Step 1	Obtain vehicle health report and check for current Engine Control Module (ECM) calibration.	Decision
Perform Obtain Vehicle Health Report(page 2107). Is ECM calibration current?		Yes: Go to Step 2. No: Ensure vehicle has latest ECM calibration. After repairs are complete, retest for SPN 1136 FMI 0.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 1136 FMI 0. Is EST DTC list SPN 1136 FMI 0 active or pending?		Yes: Replace Engine Control Module (ECM)), following approved warranty procedures. After repairs are complete, retest for SPN 1136 FMI 0. No. Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 1136 FMI 0 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 1387 FMI 31 - Altitude Reference Adder Fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Altitude Reference Adder Strategy (ARA) General Fault {Comparison of Engine Exhaust Gas Pressure with Engine Intake Manifold 1 Pressure and Barometric Pressure}	[Absolute value of difference between Barometric Pressure and Engine Intake Manifold 1 Pressure > 30 kPa AND Absolute value of difference between Engine Exhaust Gas Pressure and Barometric Pressure > 30 kPa AND Absolute value of difference between Engine Exhaust Gas Pressure and Engine 1 Intake Manifold Pressure > 30 kPa AND Engine Wastegate Actuator Position Command] < 100 %	Key ON Time after Key ON > 0 seconds Battery Voltage > 9 Volts AND < 16 Volts [1. Engine Speed < 50 RPM 2. Engine Fuel Mass Command < 10 mg/stk 3. Engine Wastegate Actuator Position Command < 100 % 4. Engine Throttle position < 10 % 5. Engine Exhaust Gas Recirculation Valve Position Command < 40 % Minimum time entry conditions (1) through (5) - mentioned above are satisfied] > 2 seconds OR [Engine Speed < 100 RPM AND Engine Fuel Mass Command] < 100 mg/stk SPN / FMI 108/3,108/4, 1209/3,1209/4,102/3, and 102/4 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) determines that it has exceeded 98% CPU load.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 102 FMI 2, 3, 4, 7, 16, and 18 (IMP)	• SPN 108 FMI 2, 3, and 4 (BARO)	• SPN 628 FMI 12 (ECM)	• SPN 629 FMI 12 (ECM)
• SPN 1209 FMI 0 and 7 (AMS)	• SPN 1209 FMI 1, 3, and 4 (EBP)		

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Barometric Absolute Pressure (BARO), Exhaust Back Pressure (EBP), and Intake Manifold Pressure (IMP) do not agree
- Biased, damaged, or failed BARO (ECM), EBP, or IMP sensor
- Biased, failed, or damaged actuator PWR circuit

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1030). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1387 FMI 31.

Step 2	Check for active or pending fault codes.	Decision
Using EST with ServiceMaxx™ software. Key ON, check DTC list for SPN 1387 FMI 31. Is EST DTC list SPN 1387 FMI 31 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Exhaust Back Pressure (EBP) and Intake Manifold Pressure (IMP) sensor connectors.	Decision
A. Key OFF. B. Disconnect EBP and IMP sensor connectors. C. Check EBP and IMP sensor and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EBP and IMP sensor connector, harness, and terminals clean and undamaged?		Yes: Return vehicle to customer. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1387 FMI 31.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 2630 FMI 2 fault code diagnostics.

ECT1 Sensor (Engine Coolant Temperature 1)

Overview of ECT1 Sensor Group

SPN	FMI	Description
110	2	ECT1 signal erratic, intermittent, or incorrect (page 1035)
110	3	ECT1 signal Out of Range HIGH (page 1040)
110	4	ECT 1 signal Out of Range LOW (page 1046)
110	17	ECT1 stuck in range Low (page 1050)
110	18	Engine Coolant System below closed loop minimum temperature (page 1055)
1659	20	ECT1 below expected: Check Thermostat (page 1060)

Overview

The Engine Coolant Temperature 1(ECT1) sensor provides a feedback signal to the Engine Control Module (ECM) indicating engine coolant temperature. During engine operation, the ECM will monitor the ECT1 signal to control the following features: Engine Warning and Protection System (EWPS); Cold Ambient Protection (CAP); Idle Shutdown Timer (IST); Cold idle advance; and Coolant compensation

The EWPS is an optional feature that can be enabled or disabled. When the EWPS is enabled, the operator is warned of an overheat condition and, if programmed, will shutdown the engine.

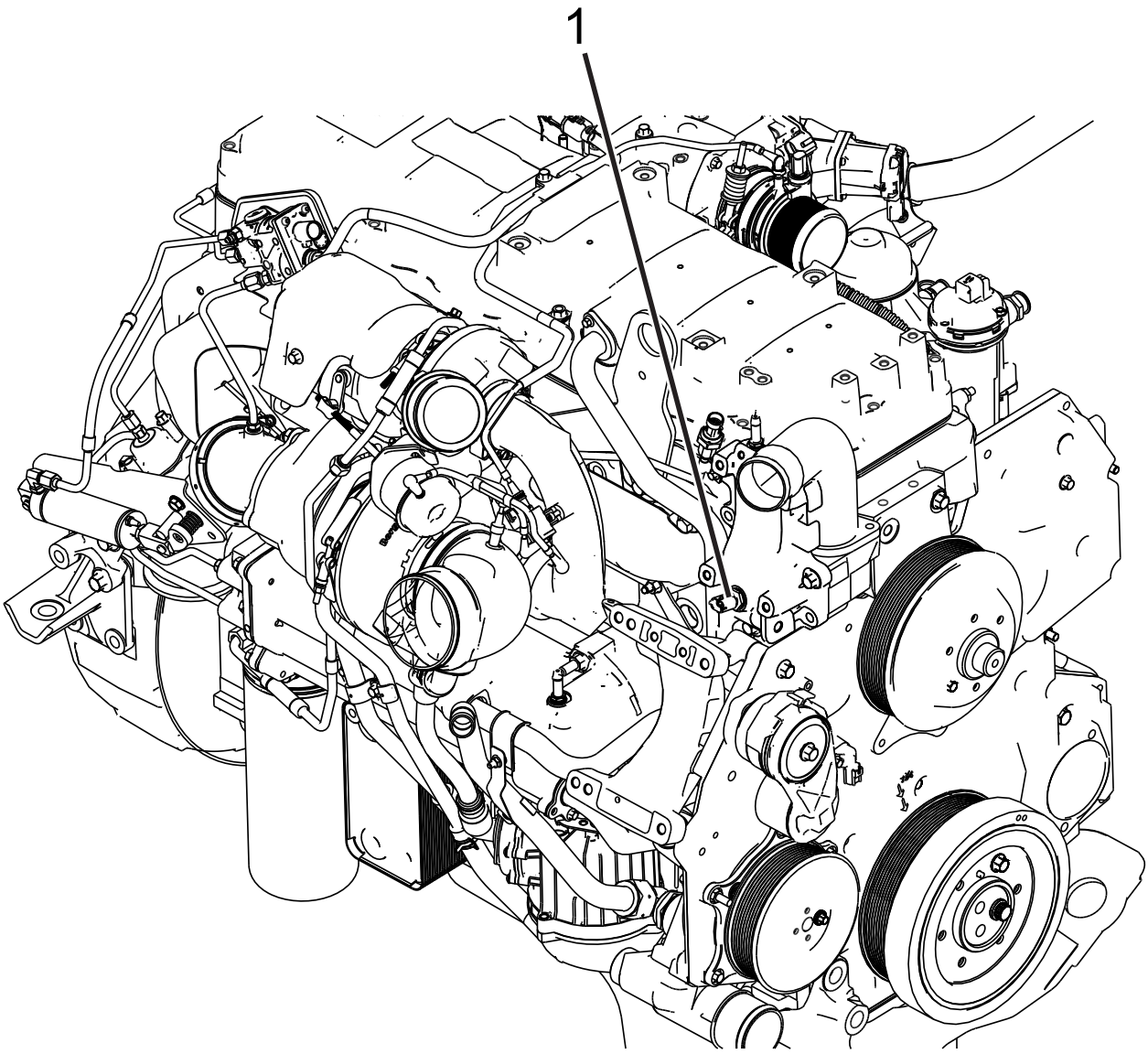


Figure 378 ECT1 Sensor Location

1. ECT1 sensor

SPN 110 FMI 2 - ECT1 signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant Temperature 1 (ECT1) does not agree with other sensors	Difference between ECT1 and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) CACOT, TC2CIT, IMT, IAT, and EOT are all within 59°F (15°C) of each other

Fault Overview

ECM Compares Engine Coolant Temperature 1 (ECT1) sensor to Intake Air Temperature (IAT), Turbocharger 2 Compressor Intake Temperature (TC2CIT), Charge Air Cooler Outlet Temperature (CACOT), Intake Manifold Temperature (IMT), and Engine Oil Temperature (EOT) sensors at Key ON after a cold soak.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 110 FMI 3 and 4 (ECT1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (After Cold Soak)

Possible Causes

- High resistance in ECT1 circuit
- High resistance in SIG GND circuit
- Failed ECT1 sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1035). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 110 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 110 FMI 2. Is EST DTC list SPN 110 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Engine Coolant Temperature 1 (ECT1) connector.	Decision
A. Key OFF. B. Disconnect ECT1 connector. C. Check ECT1 and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ECT1 connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 110 FMI 2.

Pin-Point Tests (SPN 110 FMI 2)

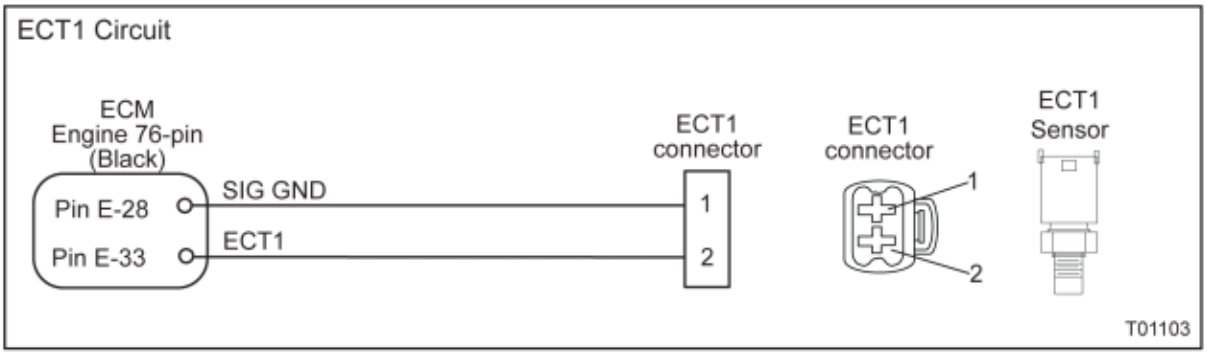
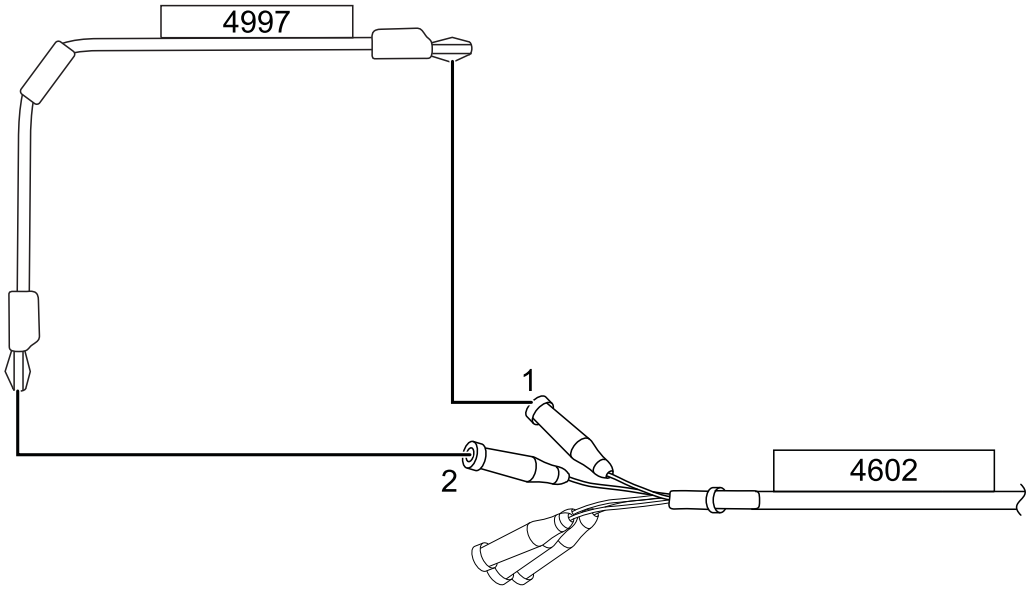


Figure 379 Engine Coolant Temperature 1 (ECT1) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



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Figure 380 Test 1 Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Engine Coolant Temperature 1 (ECT1) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave ECT1 sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor engine coolant temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace ECT1 sensor. After repairs are complete, retest for SPN 110 FMI 2.
	No: Go to Test 2.

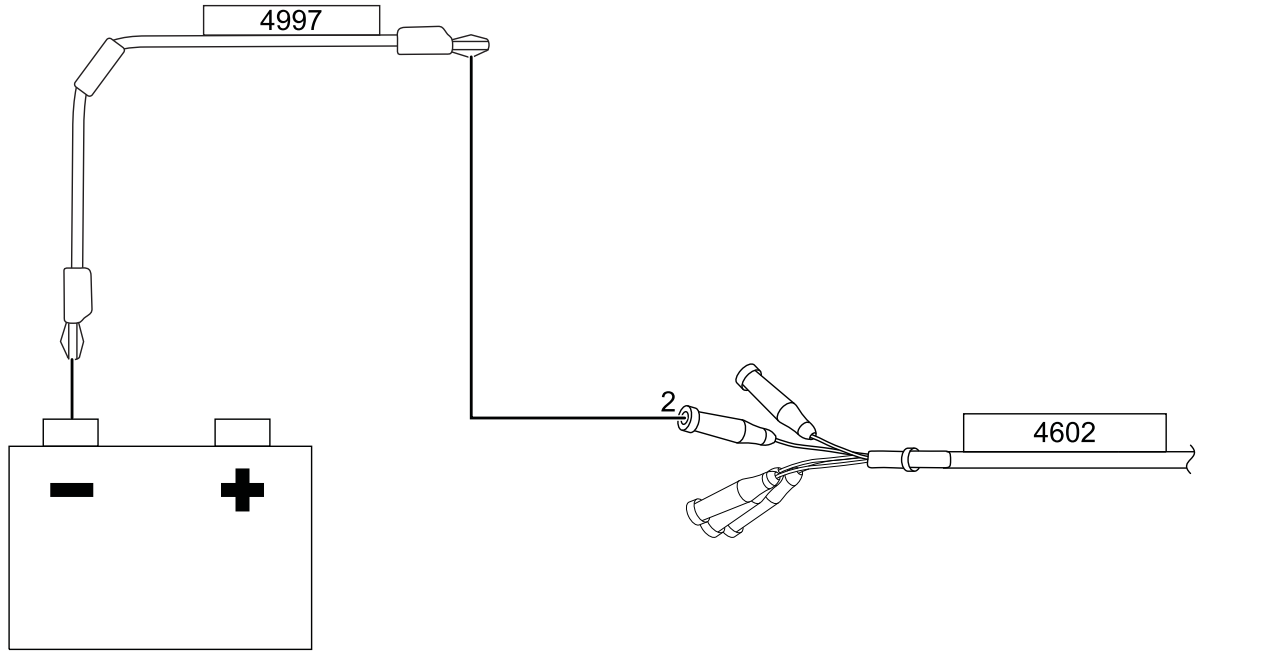


Figure 381 Test 2 ECT1 Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Coolant Temperature 1 (ECT1) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave ECT1 sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor engine coolant temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace SIG GND circuit between EGT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 110 FMI 2.
	No: Replace SIG circuit between EGT pin-2 and ECM pin E-33. After repairs are complete, retest for SPN 110 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 110 FMI 2 fault code diagnostics.

SPN 110 FMI 3 - ECT1 Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant Temperature 1 (ECT1) sensor signal reading is greater than expected.	ECT1 sensor voltage > 4.80 Volts	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects ECT1 signal is greater than 4.80 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ECT1 signal circuit Open
- ECT1 signal circuit short to PWR
- SIG GND circuit Open
- Failed ECT1 sensor

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 110 FMI 3. Is EST DTC list SPN 110 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at ECT1 sensor.	Decision
A. Key OFF. B. Disconnect ECT1 sensor connector. C. Check ECT1 sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the ECT1 sensor, connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests (SPN 110 FMI 3). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 110 FMI 3.

Pin-Point Tests (SPN 110 FMI 3)

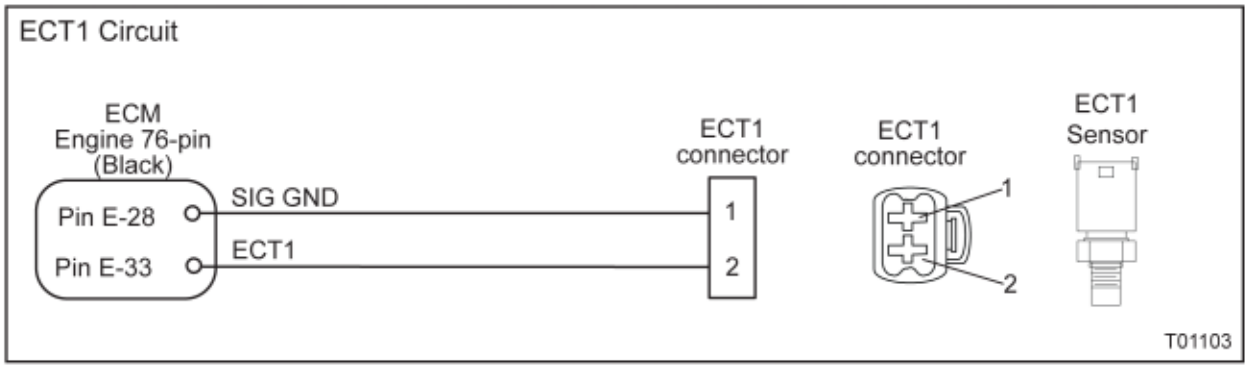


Figure 382 ECT1 Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM) ZTSE4357
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

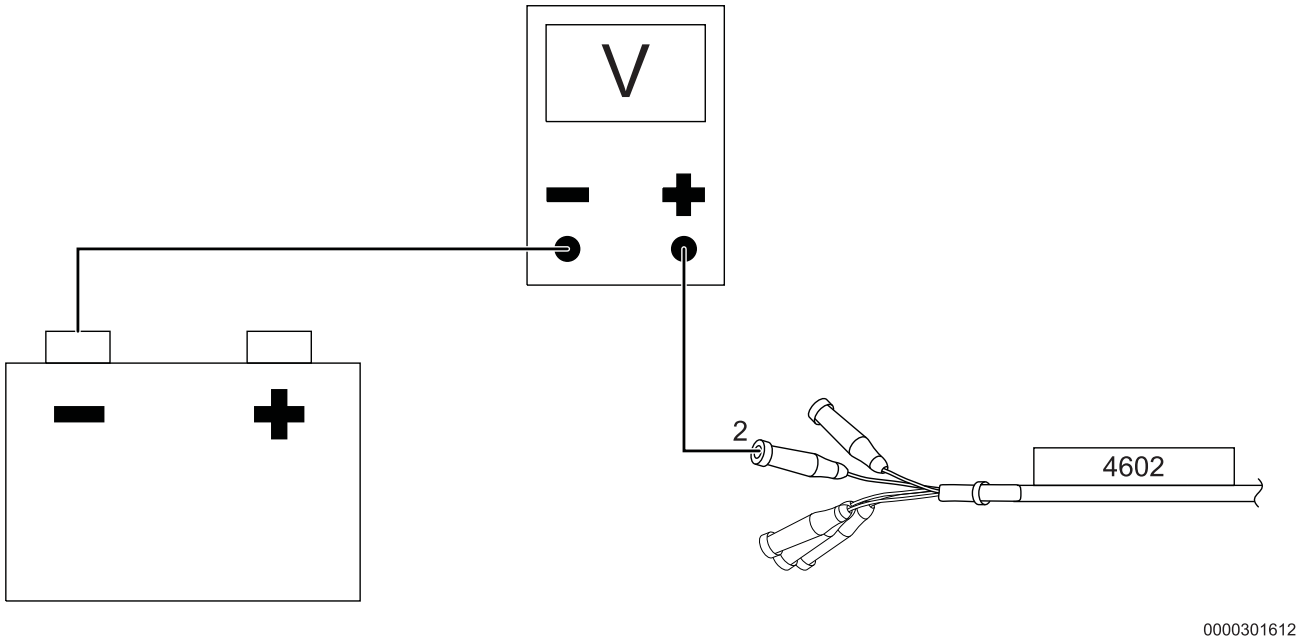
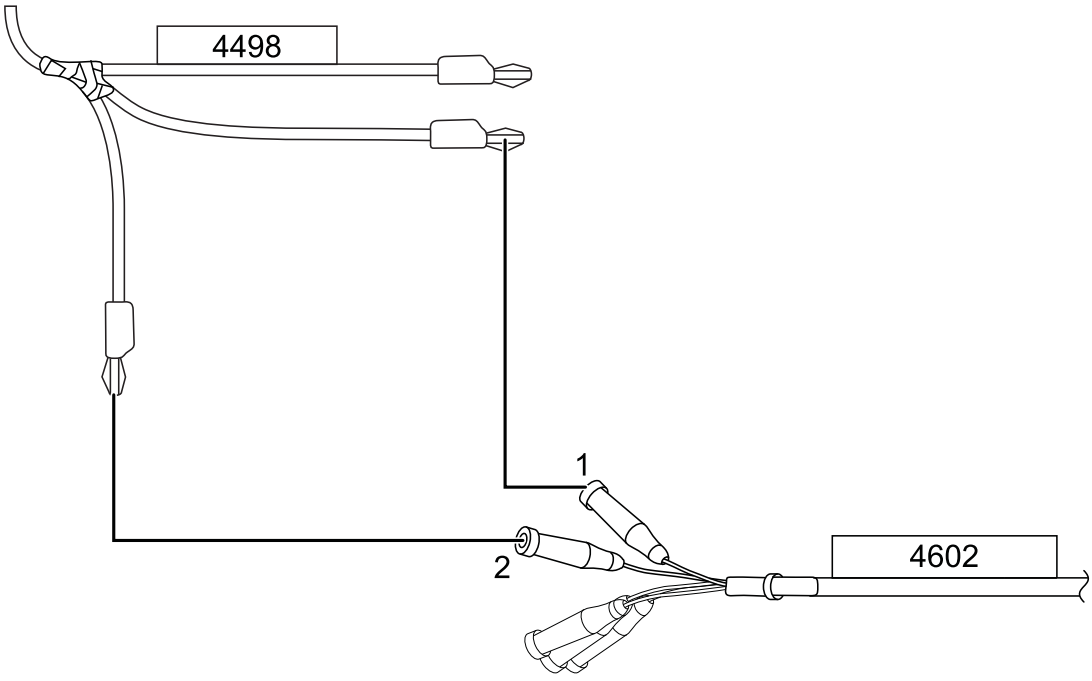


Figure 383 Test 1 ECT1 Sensor Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4602 to vehicle harness and leave Engine Coolant Temperature 1 (ECT1) sensor disconnected. C. Key ON.

Test 1	Specification
Use a Digital Multimeter (DMM) to measure voltage between Breakout Harness ZTSE4602 pin-2 and known good ground.	< 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to power between ECT1 pin-2 and Engine Control Module (ECM) pin E-33. After repairs are complete, retest for SPN 110 FMI 3.
	No: Go to Test 2.



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Figure 384 Test 2 ECT1 Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4602 to vehicle harness and leave ECT1 sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-2 of Breakout Harness ZTSE4602 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™

Test 2	Specification
Using EST with ServiceMaxx™, clear Diagnostic Trouble Code (DTC) list.	SPN 110 FMI 4 sets in DTC list.
Decision	
Does SPN 110 FMI 4 set after DTC list is cleared?	Yes: Replace ECT1 sensor. After repairs are complete, retest for SPN 110 FMI 3.
	No: Go to Step 3.

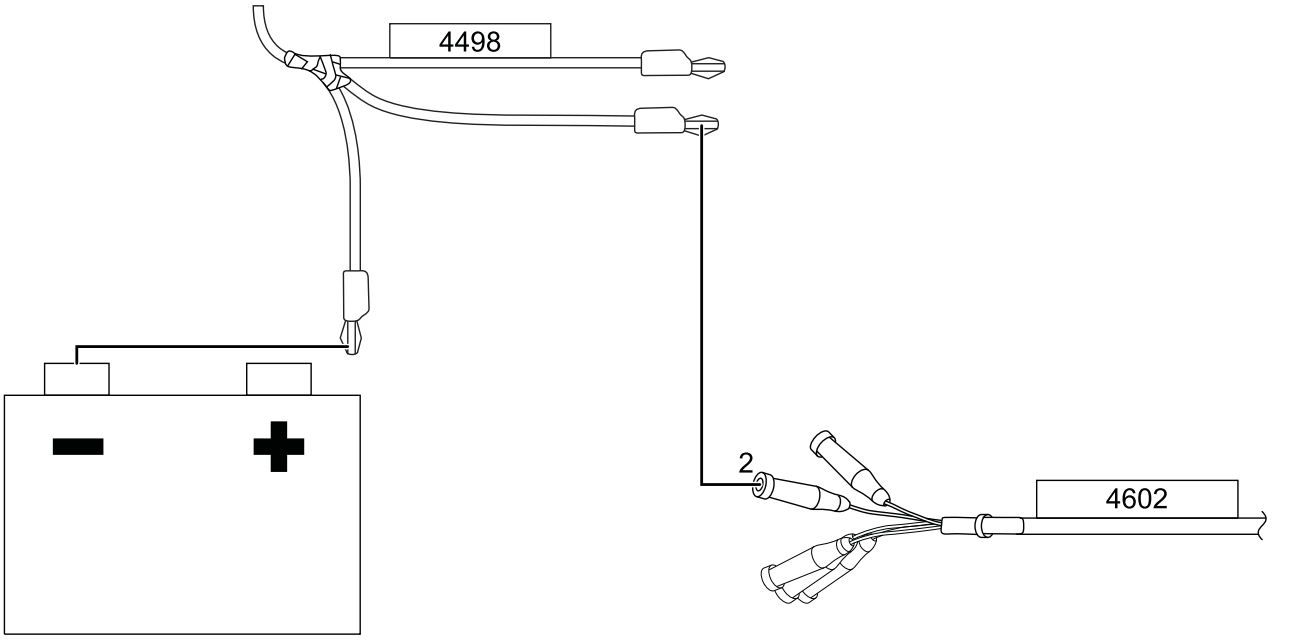


Figure 385 Test 3 ECT1 Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4602 to vehicle harness and leave ECT1 sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 of Breakout Harness ZTSE4602 to ground. D. Connect EST to vehicle Diagnostic Connector. E. Key ON. Log in to ServiceMaxx™

Test 3	Specification
Using EST with ServiceMaxx™, clear DTC list.	SPN 110 FMI 4 sets in DTC list.
Decision	
Does SPN 110 FMI 4 set after DTC list is cleared?	Yes: Repair Open between ECT1 pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 110 FMI 3.
	No: Repair Open between ECT1 pin-2 and ECM pin E-33. After repairs are complete, retest for SPN 110 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 110 FMI 3 fault code diagnostics.

SPN 110 FMI 4 - ECT1 signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Engine Coolant Temperature 1 Sensor Signal Out of Range Low	Engine Coolant Temperature 1 Sensor Voltage < 0.17 Volts (> 162.5 °C)	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Engine Coolant Temperature 1 (ECT1) sensor signal voltage is less than .17 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ECT1 circuit short to GND
- Failed ECT1 sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1046). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 110 FMI 4.

Step 2	Inspect connections at Engine Coolant Temperature 1 (ECT1) sensor.	Decision
A. Key OFF. B. Disconnect ECT1 sensor connector. C. Check ECT1 sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the ECT1 sensor, connector, harness, and terminals clean and undamaged?		Yes: Perform pin-point tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 110 FMI 4.

Pin-Point Tests (SPN 110 FMI 4)

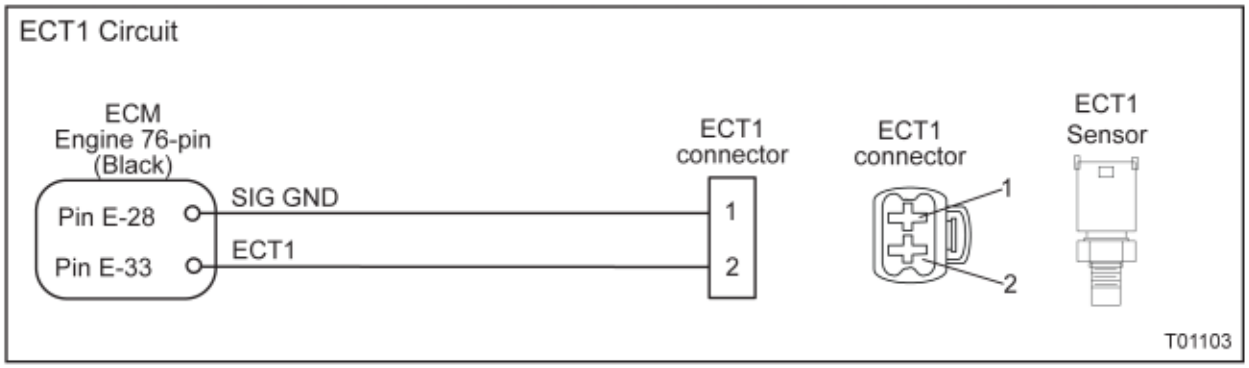


Figure 386 ECT1 Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Engine Coolant Temperature 1 (ECT1) electrical connector. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log into ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	DTC list SPN 110 FMI 3 sets
Decision	
Does SPN 110 FMI 3 set after DTC list is cleared?	Yes: Replace ECT1 sensor. After repairs are complete, retest for SPN 110 FMI 4.
	No: Repair short to GND between ECT1 connector pin-2 and ECM pin E-33. After repairs are complete, retest for SPN 110 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 110 FMI 4 fault code diagnostics.

SPN 110 FMI 17 - ECT1 stuck in range Low

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant Temperature stuck in Range Low monitor	Engine coolant temperature < 104°F (40°C)	Key ON Modeled Engine Coolant Temp ≥ 104°F (40°C) Engine Coolant Temperature at Engine Startup ≥ 104°F (40°C) Engine Air Intake Temperature ≥ -40°F (-40°C) Engine Run Mode Active Timer > 120 seconds Exhaust Brake Position Control ≤ 99.97% NOT [{1. Mass of Fuel ≤ 28 mg/stk AND 2. Engine Speed} ≤ 740 RPM Condition 1 and 2 listed Above True for at least] ≥ 300 seconds Ambient Pressure {Calibrated Out} > 1.07 psi (7.363 kPa) Cold Ambient protection Mode Not active NOT in active regeneration PTO Mode NOT Active [{Percentage time spent below ≤ 740 RPM within a drive cycle} < 0.35 * 100% OR {Cumulative time spent below ≤ 740 RPM within a drive cycle] <300 seconds SPN / FMI 132/3, 132/4, 132/0, 132/1, 172/3, 172/4, 172/2, 1173/2, 2630/2, 108/3, 108/4, 4765/3, 4765/4, 110/3, 110/4, 110/2, 175/3, 1754, 175/2, 164/0, 164/3, 164/4, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5395/0, 5395/1, 1173/16, 651/14, 652/14, 653/14, 654/14, 655/14, 656/14, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31, 110/18, 4257/0, 4257/1, 164/16, and 164/18 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) determines Engine Coolant Temperature 1 (ECT1) is stuck in Range Low monitor.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 110 (ECT1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Thermostat stuck open
- Engine fan stuck on
- Low coolant level
- EFC short to GND
- Failed ECT1

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1051). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 110 FMI 17.

Step 2	Check coolant level	Decision
Perform visual inspection of deaeration tank level. Is deaeration tank level between Cold level and Hot level?		Yes: Go to Step 3. No: Fill or drain deaeration tank to operating level. After repairs are complete, retest for SPN 110 FMI 17.

Step 3	Check for failed Engine Coolant Temperature 1 (ECT1)	Decision
Start and run engine. Using Digital IR Thermometer, ZTSE4799, measure ECT1 temperature sensor reading. Is thermometer reading within 10°F (-12.2°C) of ECT1 reading?		Yes: Go to Step 4. No: Replace ECT1 sensor. After repairs are complete, retest for SPN 110 FMI 17.

Step 4		Decision
With engine running, using Digital IR Thermometer, ZTSE4799, measure upper radiator hose temperature after thermostat has opened and compare to ECT1 sensor reading. Is thermometer reading on upper radiator hose within 5°F (-15°C) of ECT1 reading after thermostat opens?		Yes: Perform Pin-Point Tests. No: Replace thermostat. After repairs are complete, retest for SPN 110 FMI 17.

Pin-Point Tests (SPN 110 FMI 17)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908 (EFAN)

- Digital Multimeter (DMM)

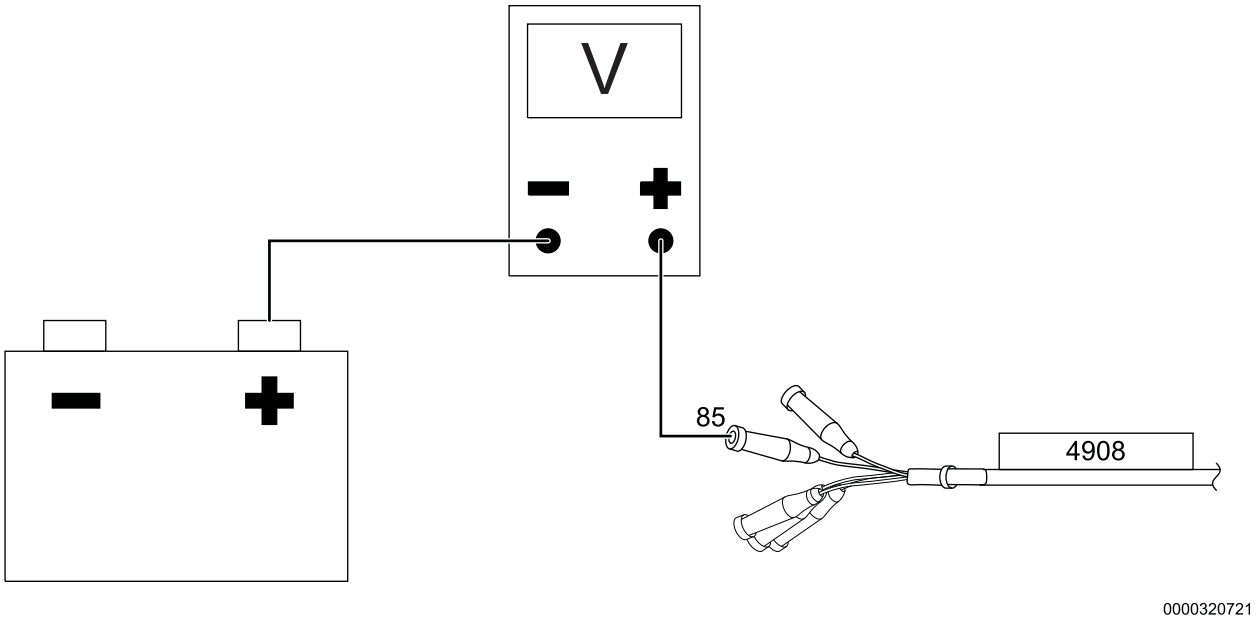


Figure 387 Test 1 Engine Fan Relay Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4908 to relay vehicle harness connector and leave Engine Fan Relay disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-85 and PWR.	Less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Diagnose fan clutch (See cooling system diagnostic manual. After repairs are complete, retest for SPN 110 FMI 17.
	No: Repair Short to GND between Engine Fan Relay pin-85 and Engine Control Module (ECM) pin C-58. After repairs are complete, retest for SPN 110 FMI 17.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 110 FMI 17 fault code diagnostics.

SPN 110 FMI 18 - Engine Coolant System below closed loop minimum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Minimum closed-loop coolant temperature not reached	Engine coolant temperature < 68°F (20°C)	Key ON Modeled Engine Coolant Temp> 68°F (20°C) Engine Coolant Temperature at Startup {Calibrated Out} ≤ 68°F (20°C) Engine Air Intake Temperature ≥ -40°F (-40°C) Engine Run Mode Active Timer > 120 seconds Exhaust Brake Position Control≤ 99.97% Ambient Pressure {Calibrated out} > 1.07 psi (7.363 kPa) Accumulated power {Calibrated Out} > -100 joules/second NOT [{1. Mass of Fuel ≤ 28 mg/stk AND 2. Engine Speed} ≤ 740 RPM Condition 1 and 2 listed Above True for at least] ≥ 300 seconds Cold Ambient protection Mode Not active NOT in active regeneration PTO Mode NOT Active [{Percentage time spent below ≤ 740 RPM within a drive cycle} < 0.35 *100% OR {Cumulative time spent below ≤ 740 RPM within a drive cycle] < 300 seconds SPN / FMI 132/3, 132/4, 132/0, 132/1, 172/3, 172/4, 172/2, 1173/2, 2630/2, 108/3, 108/4, 4765/3, 4765/4, 110/3, 110/4, 110/2, 175/3, 1754, 175/2, 164/0, 164/3, 164/4, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5395/0, 5395/1, 1173/16, 651/14, 652/14, 653/14, 654/14, 655/14, 656/14, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31, 4257/0, 4257/1, 164/16, 164/18, and 110/17 are NOT Active

Fault Overview

Fault sets when minimum closed-loop coolant temperature of less than 68°F (20°C) is not reached.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 110 FMI 17 (ECT1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Thermostat stuck open
- Engine fan stuck on
- Low coolant level
- EFC Short to GND
- Failed ECT1

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Fault(page 1056). Is EST DTC list free of Associated Fault?		Yes: Go to Step 2. No: Repair Associated Fault. After repairs are complete, retest for SPN 110 FMI 17.

Step 2	Check coolant level	Decision
Perform visual inspection of deaeration tank level. Is deaeration tank level between Cold level and Hot level?		Yes: Go to Step 3. No: Fill or drain deaeration tank to operating level. After repairs are complete, retest for SPN 110 FMI 17.

Step 3	Check for failed Engine Coolant Temperature 1 (ECT1)	Decision
Start and run engine. Using Digital IR Thermometer, ZTSE4799, measure ECT1 temperature sensor reading. Is thermometer reading within 10°F of ECT1 reading?		Yes: Go to Step 4. No: Replace ECT1 sensor. After repairs are complete, retest for SPN 110 FMI 17.

Step 4		Decision
With engine running, using Digital IR Thermometer, ZTSE4799, measure upper radiator hose temperature after thermostat has opened and compare to ECT1 sensor reading. Is thermometer reading on upper radiator hose within 5°F of ECT1 reading after thermostat opens?		Yes: Perform Pin-Point Tests. No: Replace thermostat. After repairs are complete, retest for SPN 110 FMI 17.

Pin-Point Tests (SPN 110 FMI 17)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908 (EFAN)
- Digital Multimeter (DMM)

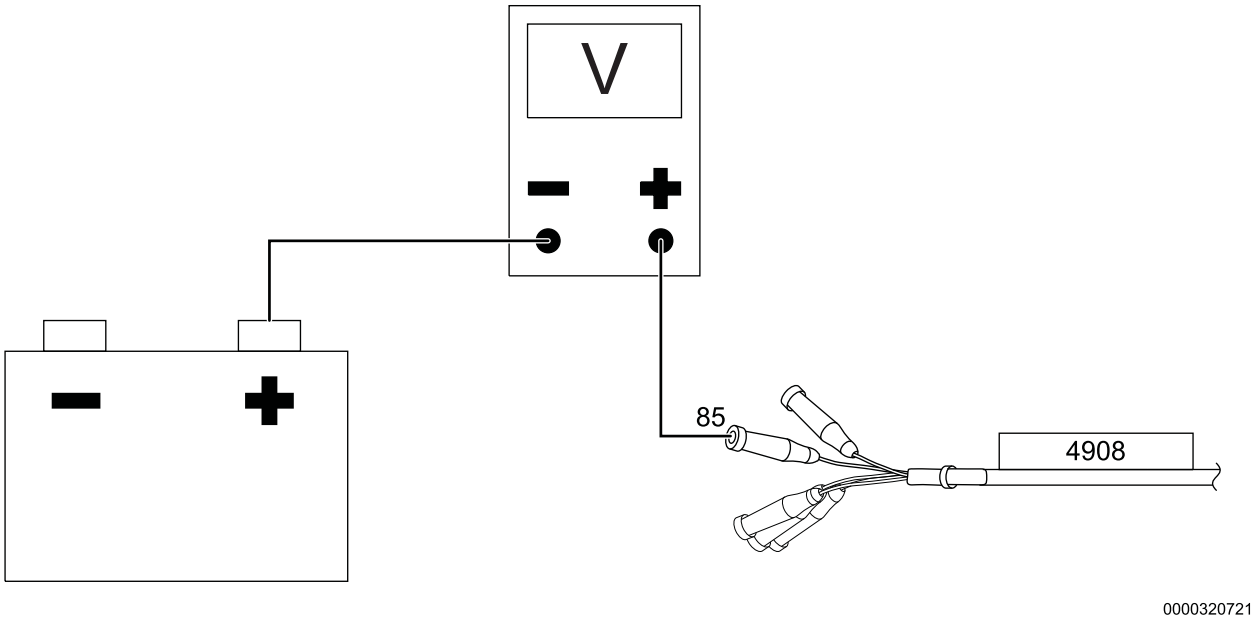


Figure 388 Test 1 Engine Fan Relay Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4908 to relay vehicle harness connector and leave Engine Fan Relay disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-85 and PWR.	< 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Diagnose fan clutch (See cooling system diagnostic manual. After repairs are complete, retest for SPN 110 FMI 18.
	No: Repair Short to GND between Engine Fan Relay pin-85 and Engine Control Module (ECM) pin C-58. After repairs are complete, retest for SPN 110 FMI 18.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 110 FMI 18 fault code diagnostics.

SPN 1659 FMI 20 - ECT1 below expected: Check Thermostat

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Thermostat Monitor: Time to warm-up	Engine Coolant Temperature < 160°F (71°C)	Key ON Modeled Engine Coolant Temp > 180°F (82.11°C) Engine Air Intake Temperature ≥ 19.4°F (-7°C) Engine Speed ≥ 0 RPM Engine Coolant Temperature at Engine Startup ≥ 15.5°F (-9.16°C) AND ≤ 127.1°F (52.84°C) Ambient Pressure > 10.7 psi (73.63 kPa) Engine Run Mode Active Timer > 120 seconds Exhaust Brake Position Control ≤ 99.97% Accumulated power {Calibrated Out} > -100 joules/second NOT [{1. Mass of Fuel ≤ 28 mg/stk AND 2. Engine Speed} ≤ 740 RPM Condition 1 and 2 listed Above True for at least] ≥ 300 seconds [{Percentage time spent below ≤ 740 RPM within a drive cycle} < 0.35 * 100% OR {Cumulative time spent below ≤ 740 RPM within a drive cycle] < 300 seconds Cold Ambient protection Mode Not active NOT in active regeneration PTO Mode NOT Active Intake Air Heater OFF SPN / FMI 132/3, 132/4, 132/0, 132/1, 172/3,4, 172/2, 1173/2, 2630/2, 108/3,4, 4765/3,4, 110/3,4, 110/2, 175/3,4, 175/2, 164/0, 164/3,4, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5395/0, 5395/1, 1173/16, 651/14, 652/14, 653/14, 654/14, 655/14, 656/14, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31,

		110/18, 4257/16, 4257/18, 164/16, 164/18, and 110/17 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 110 (ECT1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Thermostat stuck Open
- Engine fan stuck ON
- Low coolant level
- EF short to GND
- Failed ECT1

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1061). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1659 FMI 20.

Step 2	Check coolant level	Decision
Perform visual inspection of deaeration tank level. Is deaeration tank level between Cold level and Hot level?		Yes: Go to Step 3. No: Fill or drain deaeration tank to operating level. After repairs are complete, retest for SPN 1659 FMI 20.

Step 3	Check for failed Engine Coolant Temperature 1 (ECT1)	Decision
Start and run engine. Using Digital IR Thermometer, ZTSE4799, measure ECT1 temperature sensor reading. Is thermometer reading within 10°F (-12.2°C) of ECT1 reading?		Yes: Go to Step 4. No: Replace ECT1 sensor. After repairs are complete, retest for SPN 1659 FMI 20.

Step 4		Decision
With engine running, using Digital IR Thermometer, ZTSE4799, measure upper radiator hose temperature after thermostat has opened and compare to ECT1 sensor reading. Is thermometer reading on upper radiator hose within 5°F (-15°C) of ECT1 reading after thermostat opens?		Yes: Perform Pin-Point Tests. No: Replace thermostat. After repairs are complete, retest for SPN 1659 FMI 20.

Pin-Point Tests (SPN 1659 FMI 20)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4908 (EFAN)
- Digital Multimeter (DMM)

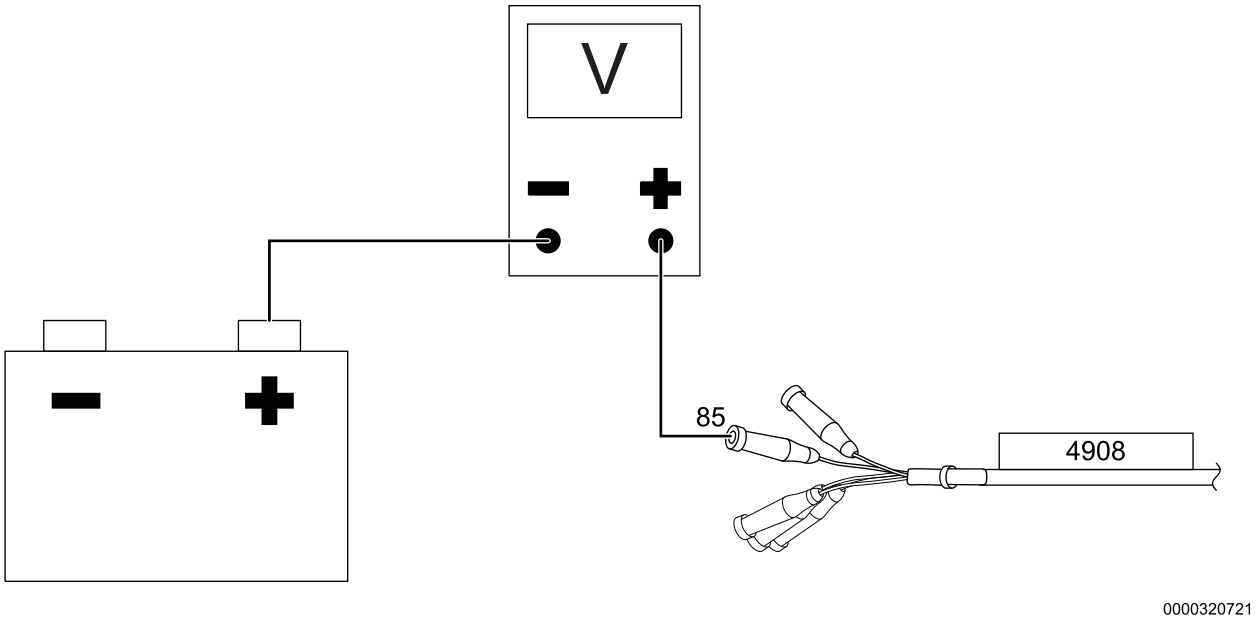


Figure 389 Test 1 Engine Fan Relay Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4908 to relay vehicle harness connector and leave Engine Fan Relay disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-85 and PWR.	< 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Diagnose fan clutch (See cooling system diagnostic manual. After repairs are complete, retest for SPN 1659 FMI 20.
	No: Repair Short to GND between Engine Fan Relay pin-85 and Engine Control Module (ECM) pin C-58. After repairs are complete, retest for SPN 1659 FMI 20.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 1659 FMI 20 fault code diagnostics.

EFP (Engine Fuel Pump)

Overview of EFP Group

SPN	FMI	Description
94	0	Fuel Delivery Pressure above Critical (page 1066)
94	1	Fuel Delivery Pressure below Critical (page 1068)
931	3	EFP short to PWR (page 1070)
931	4	EFP open load / circuit or short to GND (page 1072)

Overview

Engine Fuel Pump (EFP) supplies fuel to engine at approximately 90 psi (620 kPa). Engine Control Module (ECM) drives fuel supply pump directly, using H-Bridge driver.

Fuel Delivery Pressure (FDP) sensor is only capable of measuring up to 75 psi (517 kPa) of pressure, even though fuel pressure normally operates at 90 psi (621 kPa).

SPN 94 FMI 0 - Fuel Delivery Pressure above Critical

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel Delivery Pressure (FDP) is greater than expected.	FDP > 120 psi (827 kPa)	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Fuel Delivery Pressure (FDP) is greater than 120 psi (827 kPa).

Lamp Reaction

No Lamp Reaction.

Associated Faults

SPN 94 FMI 3 and 4 (FDP)			

Fault Facts

This fault is used to detect installation of a 2010 [0 - 75 psi (0 - 517 kPa)] FDP sensor in a 2013+ [0 - 135 psi (0 - 931 kPa)] engine.

Drive Cycle to Determine Fault Status

Key-On Engine-Running (KOER)

Possible Causes

- Incorrect FDP sensor installed

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1066). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 0.

Step 2	Monitor FDP sensor value using EST with ServiceMaxx™.	Decision
A. Key-On Engine-Running (KOER). B. Using Electronic Service Tool (EST) with ServiceMaxx™ software, monitor FDP sensor value. Is FDP steady and above 120 psi (827 kPa)?		Yes: Replace FDP sensor with correct part number for engine. After repairs are complete, retest for SPN 94 FMI 0. No: Retest for SPN 94 FMI 0.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 94 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 94 FMI 1 - Fuel Delivery Pressure below Critical

Condition / Description	Setting Criteria	Enable Conditions / Values
Fuel Delivery Pressure (FDP) below critical.	FDP < 30 psi in 10 seconds	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Fuel Delivery Pressure (FDP) is below 30 psi (207 kPa).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

• SPN 931 FMI 4 (EFP)	• SPN 94 FMI 18 (FDP)		

Fault Facts

ICP is limited with this fault.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Recent fuel system service requiring priming
- Vehicle unused for long period of time requiring priming
- Diesel fuel
- Failed Fuel Pressure Regulator (FPR)
- Low fuel level in either tank (defective fuel level gauge or transfer pump)
- Restricted fuel supply line
- Restricted pickup tube in fuel tank
- Failed or incorrectly installed secondary fuel filter
- Failed Engine Fuel Pump (EFP)
- EFP circuit Open or high resistance
- EFP GND circuit Open

Step 1	Check for associated fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1068). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 1.

Step 2	Check Fault Code Status	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 1 (EFP). Is SPN 94 FMI 1 pending or active?		Yes: Go to Fuel Fuel Delivery Pressure symptom (page 120). No: Repair SPN 94 FMI 1. After repairs are complete, retest SPN 94 FMI 1.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 94 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 931 FMI 3 - EFP short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Fuel Pump (EFP) Power Supply Circuit Shorted to High Source	Diagnostic input Pin E-69 is set to 1	Key ON Fuel Pump relay has been commanded off by Engine Control Module (ECM) for time ≥ 2 seconds

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Key ON Engine OFF (fuel pump commanded OFF)

Possible Causes

- Relay stuck ON
- Relay control wire shorted to GND
- Relay output SCB

Step 1	Check Fault Code Status	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 931 FMI 3 (EFP). Is SPN 931 FMI 3 pending or active?		Yes: Go to Fuel Fuel Delivery Pressure symptom (page 120). No: Repair SPN 931 FMI 3. After repairs are complete, retest SPN 931 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 931 FMI 3 fault code diagnostics.

SPN 931 FMI 4 - EFP open load / circuit or short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Fuel Pump (EFP) Power Supply Circuit Shorted to Low Source or Open	Diagnostic input Pin E-69 is set to 0 {No Voltage}	Key ON Fuel Pump relay has been commanded on by Engine Control Module for time ≥ 2 seconds

Fault Overview

Fault sets when Engine Control Module (ECM) Engine Fuel Pump (EFP) power supply circuit is Shorted to low source or Open.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON and fuel pump commanded ON.

Possible Causes

- Fuel Pump relay open contacts
- Open wire from B+ to relay or Blown fuse
- Relay control wire open circuit
- EFP power wire open circuit
- EFP monitoring wire open circuit

Step 1	Check Fault Code Status	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 931 FMI 4 (EFP). Is SPN 931 FMI 4 pending or active?		Yes: Go to Fuel Fuel Delivery Pressure symptom (page 120). No: Repair SPN SPN 931 FMI 4. After repairs are complete, retest SPN 931 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 931 FMI 4 fault code diagnostics.

EGR Actuator (Exhaust Gas Recirculation)

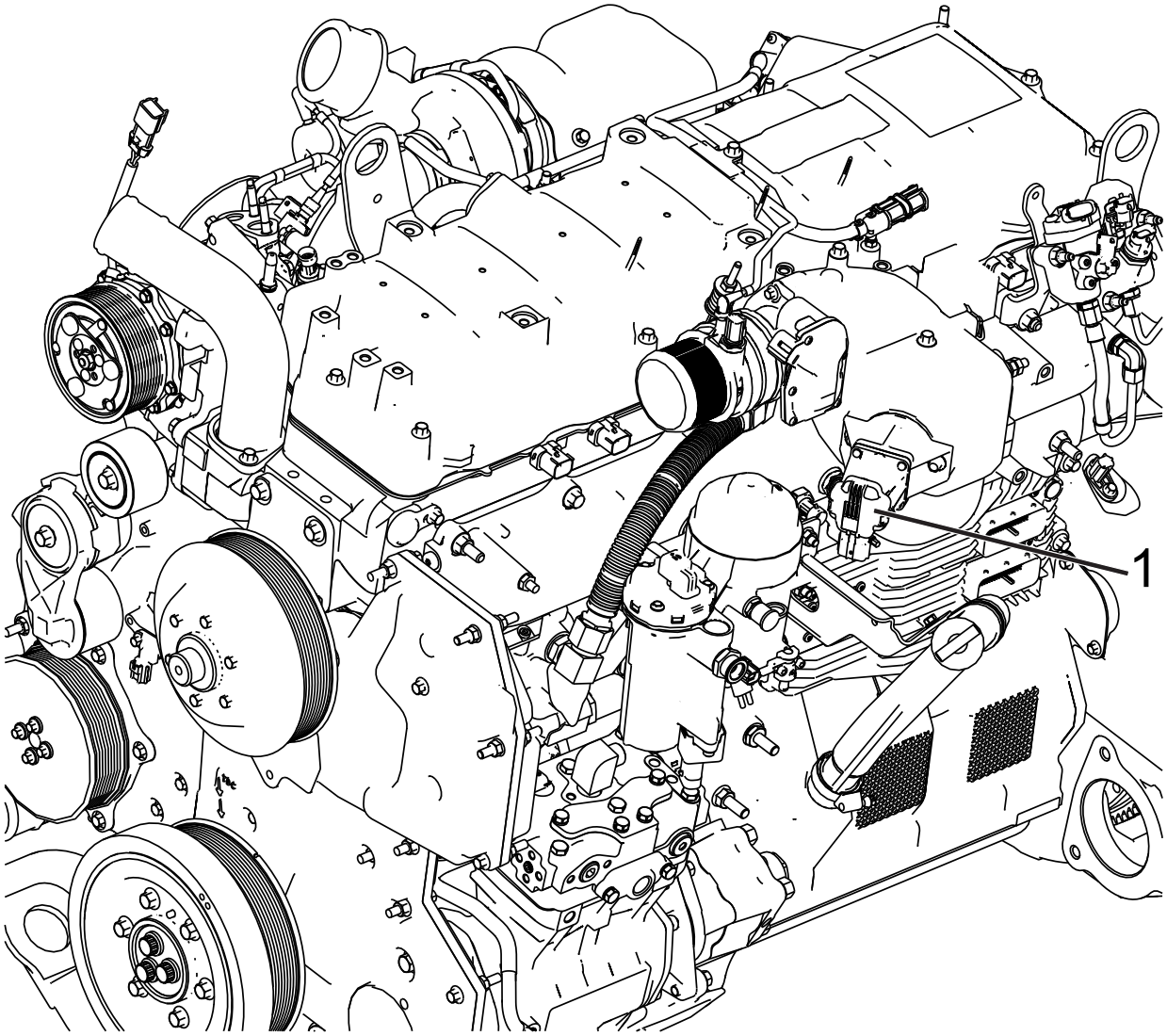
Overview of EGR Actuator Sensor Group

SPN	FMI	Description
27	0	EGRP fault: over temperature (page 1076)
27	14	EGR internal circuit failure (page 1078)
2791	2	EGR feedback communication fault (page 1080)
2791	3	EGRV supply voltage is too HIGH (page 1089)
2791	4	EGRV supply voltage is too LOW (page 1091)
2791	7	EGR Valve unable to achieve commanded position (page 1095)
2791	8	EGR valve not receiving ECM PWM signal (page 1097)
2791	12	EGR Valve Internal self test fault (page 1106)
2791	14	EGR Valve did not seat (page 1108)
4752	4	EGR Cooler Efficiency: EGR Outlet Temp above expected (page 1110)

Overview

Nitrogen Oxides (NOx) in atmosphere contribute to production of smog. NOx is formed in engines when temperatures in combustion chamber get too hot.

Exhaust Gas Recirculation (EGR) system is used to reduce amount of NOx created by the engine. EGR valve directs some exhaust into intake stream to dilute air-fuel mixture in the combustion chamber. This slows combustion and reduces formation of NOx.



0000061556

Figure 390 Exhaust Gas Recirculation (EGR) Actuator Sensor Group Location

1. EGR Valve

SPN 27 FMI 0 - EGRP fault: over temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
EGRP fault: over temperature	TBD	TBD

Fault Overview

Fault sets when Engine Control Module (ECM) senses Exhaust Gas Recirculation Valve Position (EGRP) temperature is too high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Failed EGR valve

Step 1	Perform Exhaust Gas Recirculation (EGR) Valve Operational Test	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, perform Exhaust Gas Recirculation (EGR) Valve Operational Test(page 2271). Did EGR pass operational test with no fault codes?		Yes: System OK. After repairs are complete, retest for SPN 27 FMI 0.
		No: Replace EGR valve. After repairs are complete, retest for SPN 27 FMI 0.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 27 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 27 FMI 14 - EGR internal circuit failure

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Gas Recirculation Valve Position sensor circuit faults as indicated by smart actuator	Position Sensor Output as indicated by all 3 Hall effect sensors = {Please refer to additional documentation for more details} Continuously at Low position OR Continuously at High Position	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) determines Exhaust Gas Recirculation (EGR) valve is not functioning properly when initialized.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 2791 FMI 7 (EGR)			

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EGR valve unable to seat closed
- Stuck or sticking EGR valve

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1078). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 27 FMI 14.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 27 FMI 14. Is EST DTC list SPN 27 FMI 14 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 27 FMI 14.

Step 4	Exhaust Gas Recirculation (EGR) Operational Test.	Decision
Perform EGR Operational Test(page 2271). Are there any active SPN 2791 or SPN 27 fault codes active?		Yes: Replace EGR valve. After repairs are complete, retest for SPN 27 FMI 14. No: System OK.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 27 FMI 14 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2791 FMI 2 - EGR feedback communication fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Gas Recirculation (EGR) valve communication fault	Rising edge is not detected on Pulse Width Modulation (PWM) EGR valve feedback line for time > 0.0057 seconds	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) fails to detect rising edge of a response pulse on Exhaust Gas Recirculation (EGR) position signal line within 0.0057 seconds following commanded position change.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust Gas Recirculation Position (EGRP) circuit open
- EGRP circuit shorted to ground
- Actuator (ACT) power circuit open or blown fuse
- ACT power circuit shorted to ground
- Failed Exhaust Gas Recirculation (EGR) valve

Step 1	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 2791 FMI 2. Does EST DTC list free show SPN 2791 FMI 2 as active?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2791 FMI 2.

Step 3	Inspect connections at Turbocharger 2 Wastegate (TC2WG).	Decision
A. Key OFF. B. Disconnect TC2WG connector. C. Check TC2WG and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2WG connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2791 FMI 2.

Pin-Point Tests (SPN 2791 FMI 2)

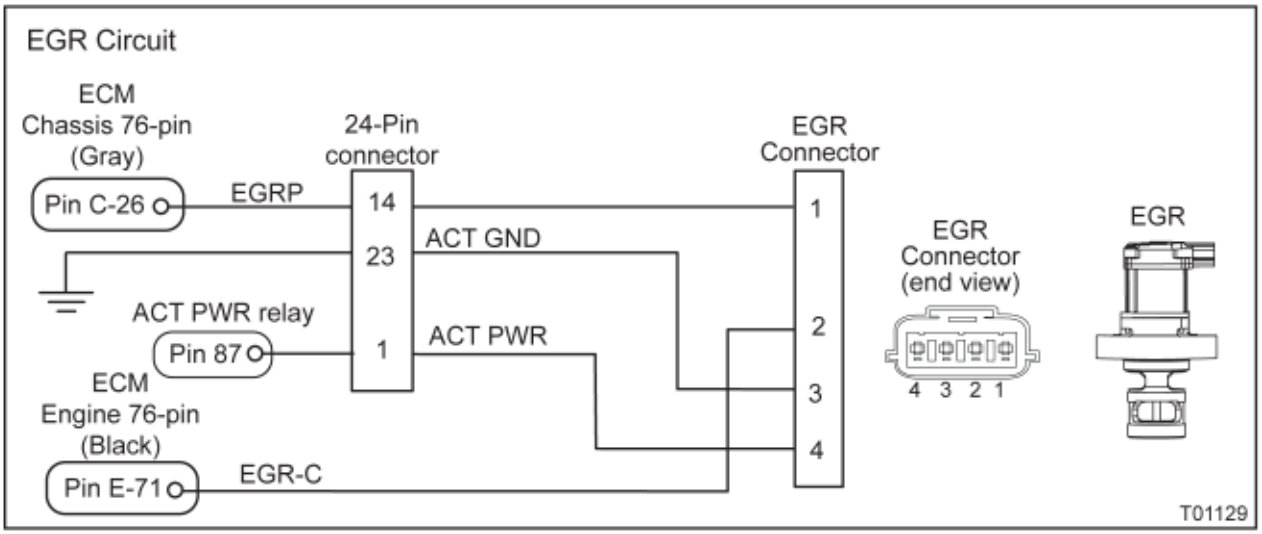


Figure 391 Exhaust Gas recirculation (EGR) Valve Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6003
- Breakout Harness ZTSE6016
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant, supporting J1939 and J1708)

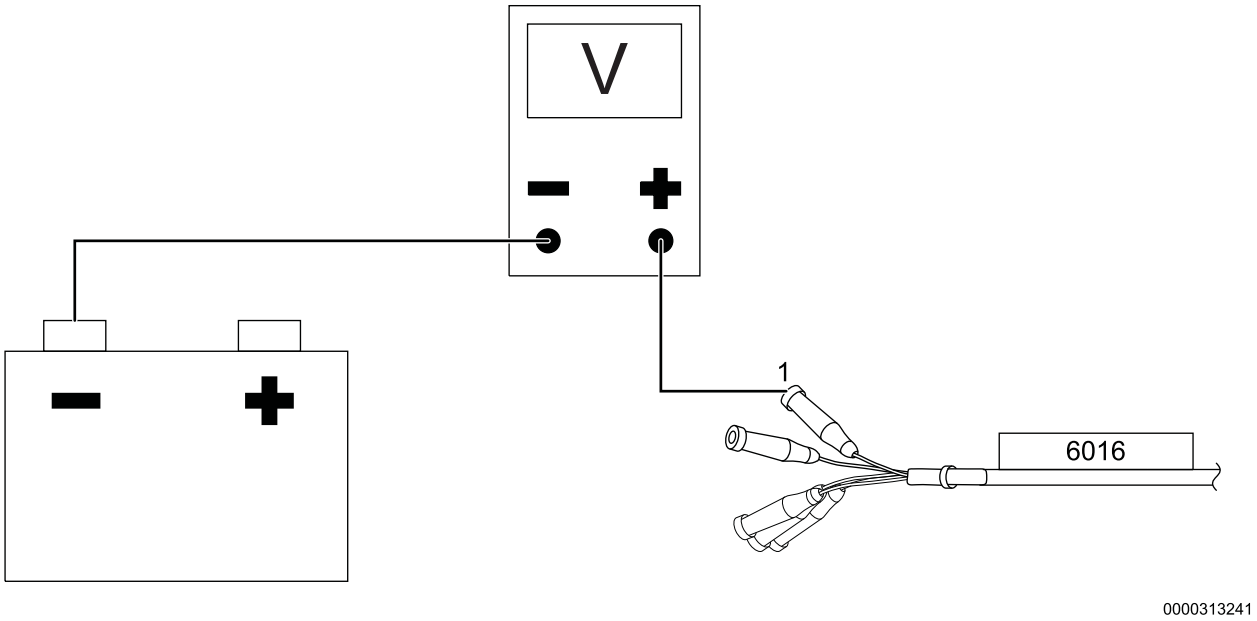


Figure 392 Test 1 Exhaust Gas Recirculation (EGR) Valve Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6016 to vehicle harness connector and leave Exhaust Gas Recirculation (EGR) valve disconnected. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6016 pin-1 and known good ground.	Less than 5.5 volts
Decision	
Is voltage less than 5.5 volts?	Yes: Go to Test 2.
	No: Repair short to power between EGR valve connector pin-1 and Engine Control Module (ECM) Chassis 76-pin connector pin C-26. After repairs are complete, retest for SPN 2791 FMI 2.

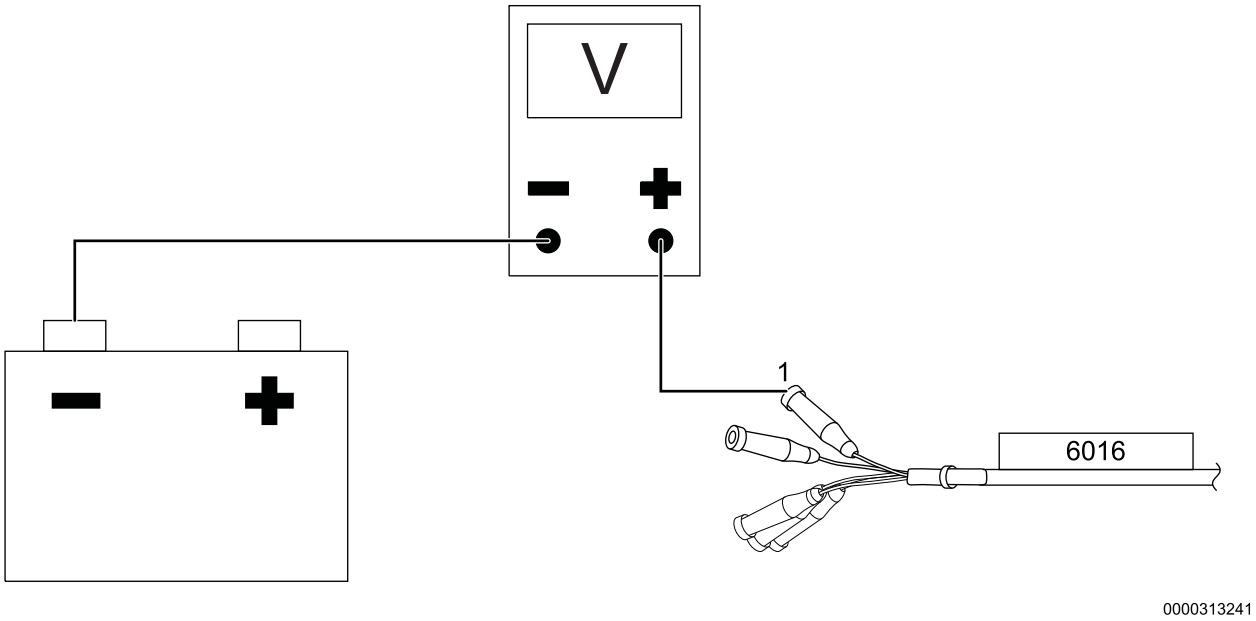


Figure 393 Test 2 Exhaust Gas Recirculation (EGR) Valve Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6016 to vehicle harness connector and leave Exhaust Gas Recirculation (EGR) valve disconnected. C. Key-On Engine-Off (KOEO).

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6016 pin-1 and known good ground.	Greater than 4.5 volts
Decision	
Is voltage greater than 4.5 volts?	Yes: Go to Test 4.
	No: Go to Test 3.

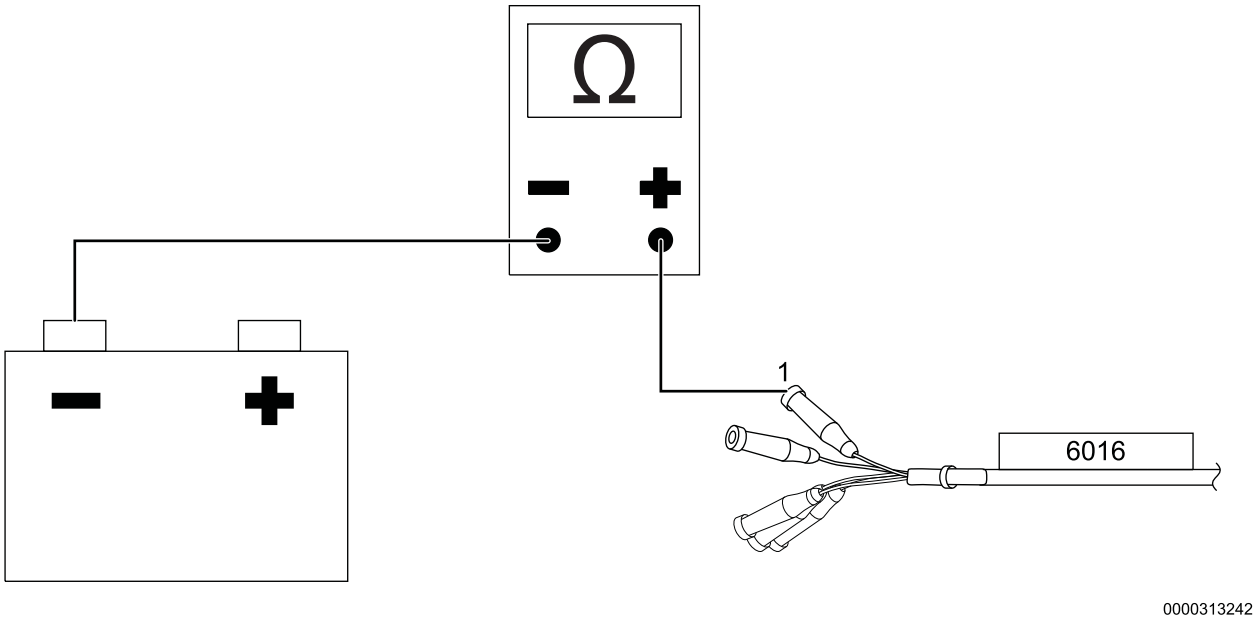


Figure 394 Test 3 Exhaust Gas Recirculation (EGR) Valve Resistance Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE6016 to vehicle harness connector and leave Exhaust Gas Recirculation (EGR) valve disconnected. C. Key-On Engine-Off (KOEO).

Test 3	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6016 pin-1 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair open circuit EGR valve connector pin-1 and Engine Control Module (ECM) Chassis 76-pin connector pin C-26. After repairs are complete, retest for SPN 2791 FMI 2.
	No: Repair short to ground between EGR valve connector pin-1 and ECM Chassis 76-pin connector pin C-26. After repairs are complete, retest for SPN 2791 FMI 2.

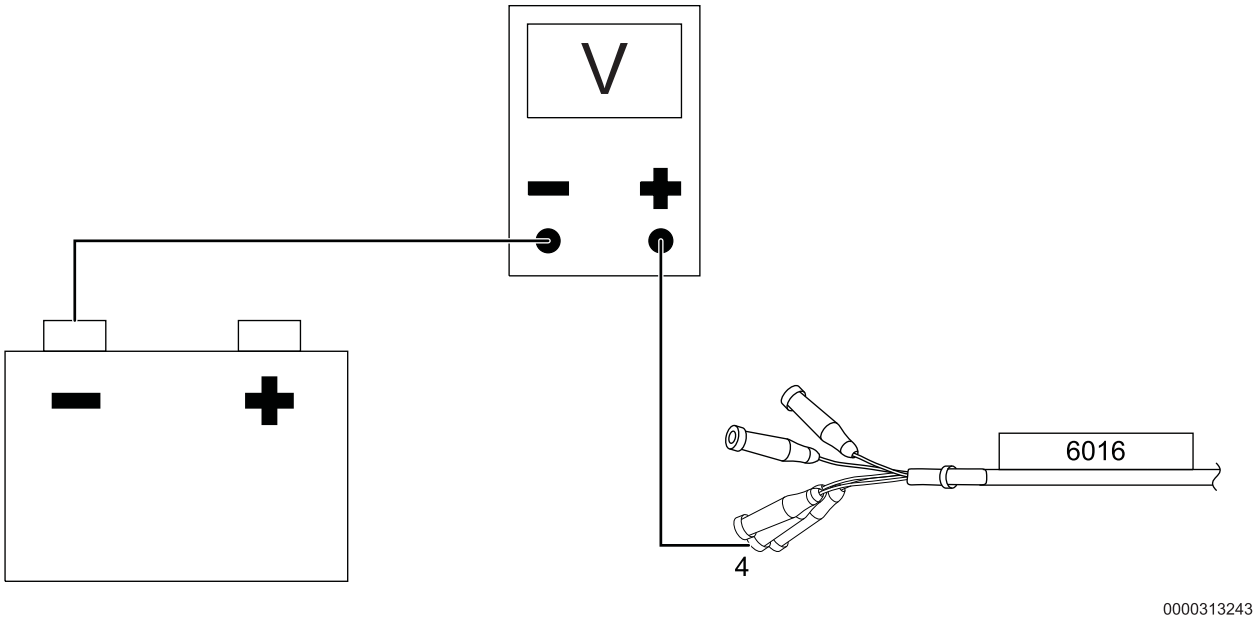


Figure 395 Test 4 Exhaust Gas Recirculation (EGR) Valve Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect Turbocharger 2 Wastegate (TC2WG) vehicle harness connector and leave wastegate disconnected. C. Connect Breakout Harness ZTSE6016 to vehicle harness connector and leave Exhaust Gas Recirculation (EGR) valve disconnected. D. Key-On Engine-Off (KOEO).

Test 4	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6016 pin-4 and known good ground.	Greater than 9 volts
Decision	
Is voltage greater than 9 volts?	Yes: Go to Test 6.
	No: Go to Test 5.

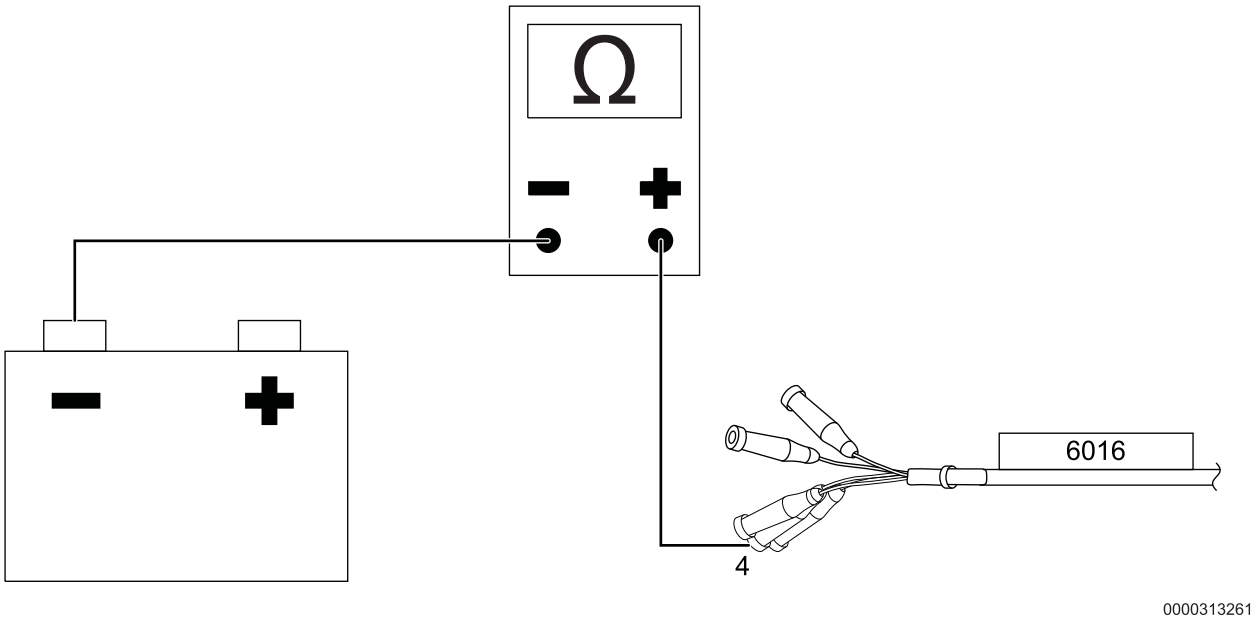


Figure 396 Test 5 Exhaust Gas Recirculation (EGR) Valve Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Turbocharger 2 Wastegate (TC2WG) vehicle harness connector and leave wastegate disconnected. C. Connect Breakout Harness ZTSE6016 to vehicle harness connector and leave Exhaust Gas Recirculation (EGR) valve disconnected. D. Key-On Engine-Off (KOEO).

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6016 pin-4 and known good ground.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair open or blown fuse between Actuator Power (ACT PWR) relay pin-87 and EGR valve connector pin-4. After repairs are complete, retest for SPN 2791 FMI 2.
	No: Repair short to ground between ACT PWR relay pin-87 and EGR valve connector pin-4. After repairs are complete, retest for SPN 2791 FMI 2.

Test 6 Setup
A. Key OFF. B. Connect Turbocharger 2 Wastegate (TC2WG) vehicle harness connector to wastegate. C. Connect Exhaust Gas Recirculation (EGR) valve vehicle harness connector to EGR valve. D. Connect Electronic Service Tool (EST) to Diagnostic Connector (page 2124).

Test 6	Specification
Perform EGR Valve Operation Verification Test. (page 2271)	Faults clear
Decision	
Do faults clear?	Yes: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).
	No: Replace EGR valve. After repairs are complete, retest for SPN 2791 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 2791 FMI 2 fault code diagnostics.

SPN 2791 FMI 3 - EGRV supply voltage is too HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
EGR Valve supply voltage	[Voltage Supply to EGR Valve > 18 Volts for time =] 5 seconds	Key ON

Fault Overview

This fault sets when Exhaust Gas Recirculation (EGR) valve receives a voltage supply of greater than 18 volts for 5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

This fault sets when Exhaust Gas Recirculation (EGR) valve receives a voltage value that is greater than 18 volts. This is NOT an EGR valve problem; it is a voltage supply problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Charging system over voltage
- Use of battery charger on boost mode

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, start engine, measure battery voltage. Is battery voltage greater than 18 volts?		Yes: Repair charging system. After repairs are complete, retest for SPN 2791 FMI 3.
		No: System OK. After repairs are complete, retest for SPN 2791 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 2791 FMI 3 fault code diagnostics.

SPN 2791 FMI 4 - EGRV supply voltage is too LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
EGR Valve supply voltage	[Voltage Supply to EGR Valve < 8 Volts for time =] 13 seconds	Key ON

Fault Overview

This fault sets when Exhaust Gas Recirculation (EGR) valve receives a voltage supply of less than 8 volts for 13 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

This fault sets when Exhaust Gas Recirculation (EGR) valve receives a voltage value that is less than 8 volts. This is NOT an EGR valve problem; it is a voltage supply problem.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low charging system voltage
- High resistance in ACT PWR circuit or relay
- High resistance in ACT GND circuit

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, start engine, measure battery voltage. Is battery voltage less than 8 volts?		Yes: Repair charging system. After repairs are complete, retest for SPN 2791 FMI 4.
		No: Perform pin-point tests.

Pin-Point Tests (SPN 2791 FMI 4)

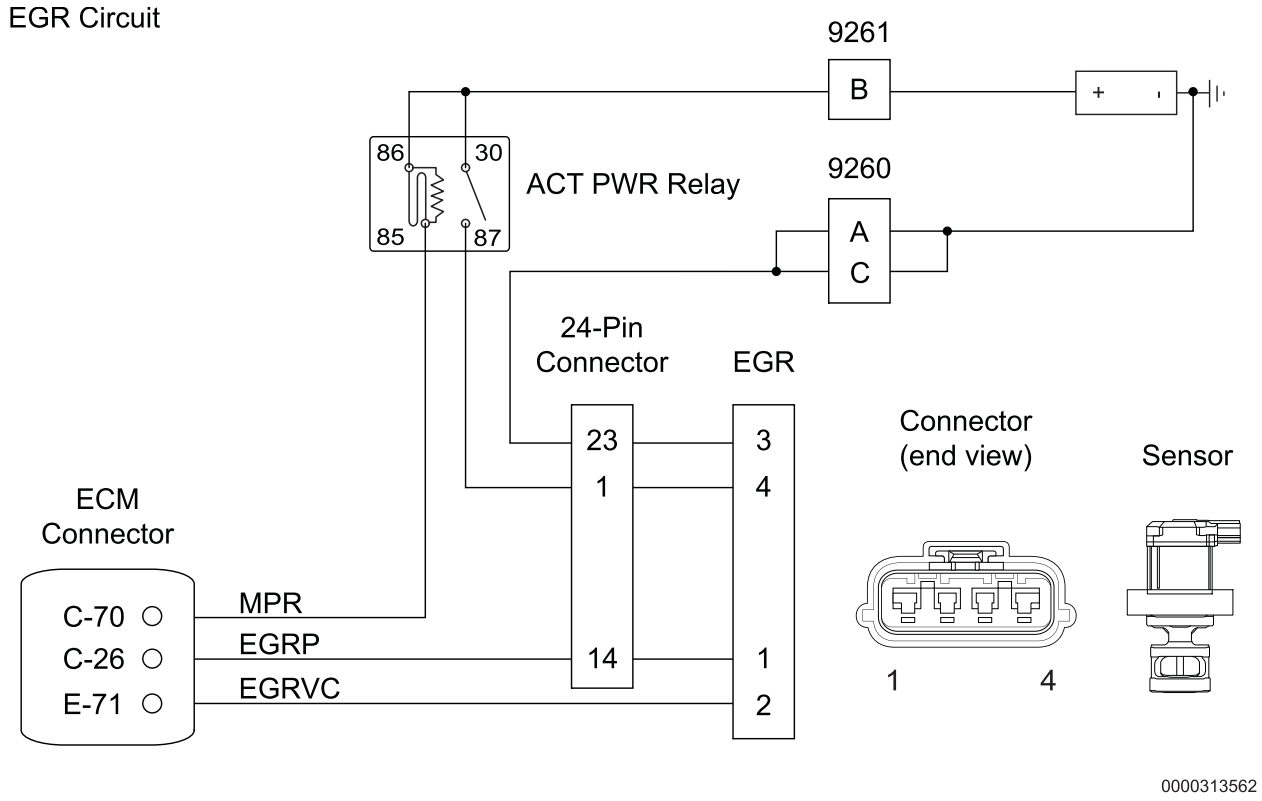


Figure 397 Exhaust Gas Recirculation (EGR) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4948
- Digital Multimeter (DMM)

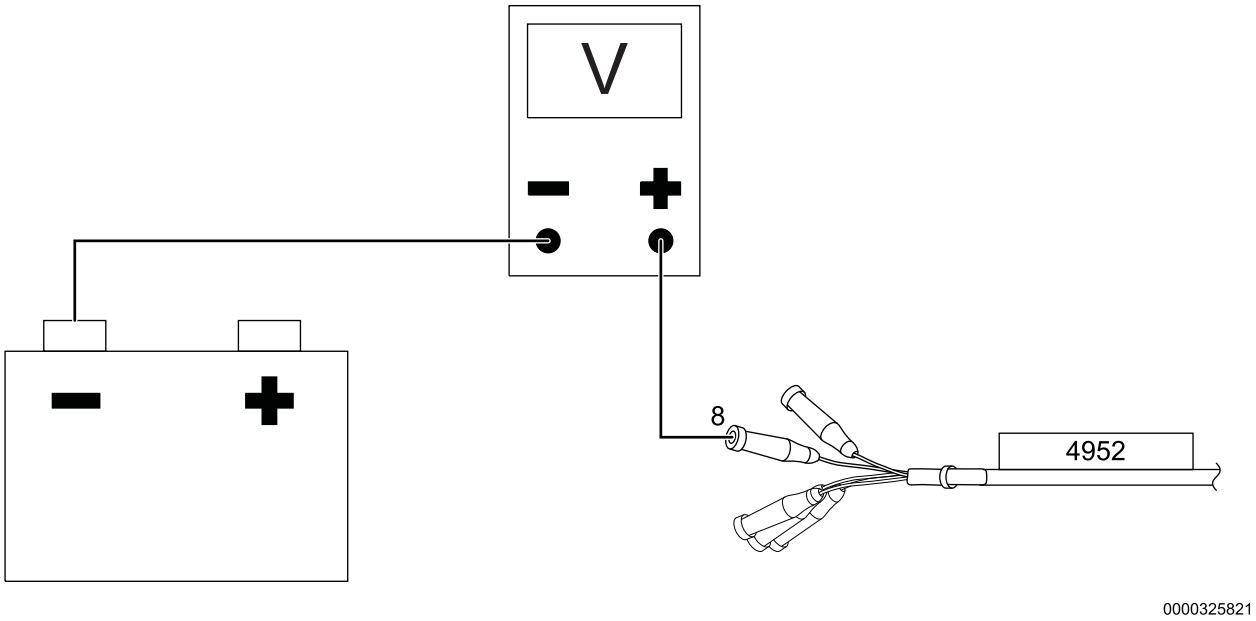


Figure 398 Test 1 Exhaust Gas Recirculation (EGR) Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Gas Recirculation (EGR) connector. C. Connect Breakout Harness ZTSE4948 to vehicle harness, leave EGR disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4948 pin-4 and known good GND.	Less than 8 volts
Decision	
Is voltage less than 8 volts?	Yes: Repair high resistance in power circuit between pin-4 and ACT PWR relay. After repairs are complete, retest for SPN 2791 FMI 4.
	No: Repair high resistance in ground circuit between pin-3 and ACT GND circuit. After repairs are complete, retest for SPN 2791 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 2791 FMI 4 fault code diagnostics.

SPN 2791 FMI 7 - EGR Valve unable to achieve commanded position

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Recirculation (EGR) valve control feedback error.	EGR valve motor duty cycle (motor duty cycle is calculated internally based on desired and actual EGR valve position) > 95% for 3 seconds continuously	Key ON 3 attempts per key cycle

Fault Overview

Fault code sets when Engine Control Module (ECM) determines Exhaust Gas Recirculation (EGR) valve is Not functioning properly when commanded.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 2791 FMI 2, 3, 4, 8, and 14 (EGR)			

Fault Facts

This fault is also used to detect EGR valve positive and negative deviation faults.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust Gas Recirculation (EGR) valve motor internal duty cycle > 95 %
- EGR valve motor stuck
- Deposits on EGR valve
- Stuck or sticking EGR valve

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1095). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2791 FMI 7.

Step 2	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR Valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2791 FMI 7.

Step 3	Test for proper Exhaust Gas Recirculation (EGR) valve operation.	Decision
Perform EGR Valve Operation Verification Test (page 2271). Is SPN 2791 FMI 7 Pending or Active in DTC list?		Yes: Replace EGR valve. Notify supervisor for further action. No: Fault no longer present at this time. After repairs are complete, retest for SPN 2791 FMI 7.

End Diagnostic Steps
After performing diagnostic steps, if SPN 2791 FMI 7 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2791 FMI 8 - EGR valve not receiving ECM PWM signal

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
PWM duty cycle from Engine Control Module to Smart EGR Valve Controller: Signal Failure	[PWM duty cycle command to EGR Valve controller < 4.001% OR > 97% for 1 second	Key ON
	[PWM frequency command to EGR Valve controller < 175 Hz OR > 325 Hz for 1 second	Key ON

Fault Overview

Fault sets when a failure of the PWM duty cycle signal from Engine Control Module (ECM) to Exhaust Gas Recirculation (EGR) valve controller.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ACT PWR relay remaining on with Key-Off
- EGRVC wire open
- EGRVC wire short to GND
- EGRVC short to PWR
- Failed Exhaust Gas Recirculation (EGR) valve

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 2791 FMI 8. Is EST DTC list SPN 2791 FMI 8 active or pending?		Yes: Perform pinpoint tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 2791 FMI 8)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4948
- Breakout Harness ZTSE4674
- Digital Multimeter (DMM)

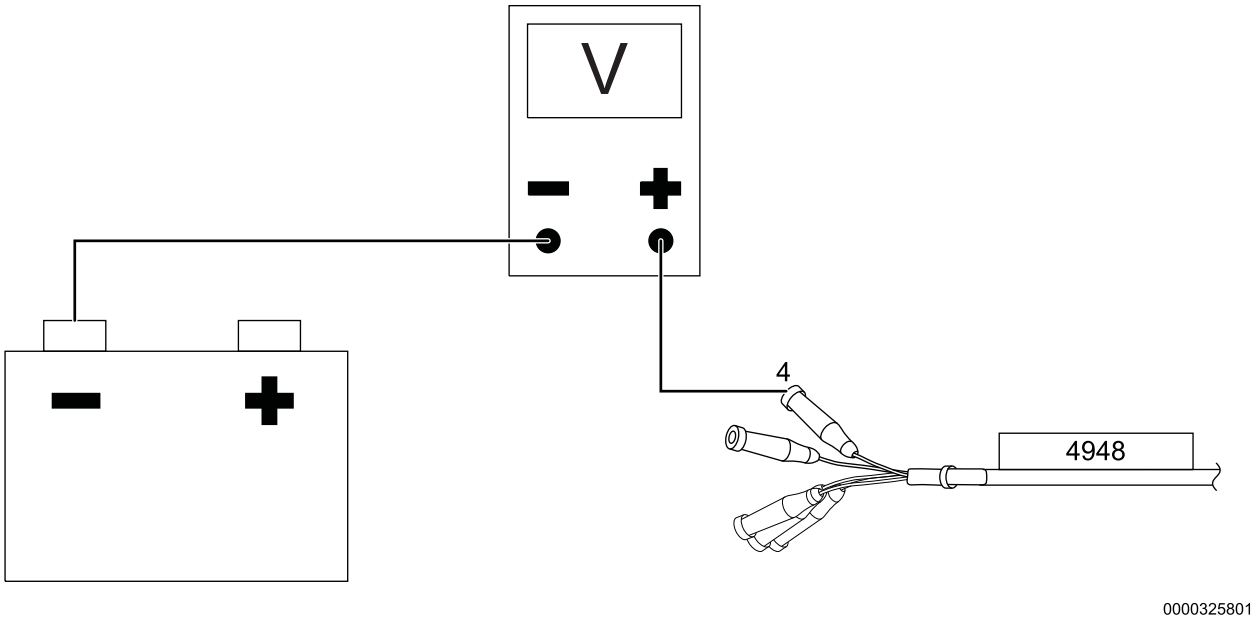


Figure 399 Test 1 Exhaust Gas Recirculation (EGR) connector Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Gas Recirculation (EGR) connector. C. Connect Breakout Harness ZTSE4948 to vehicle harness and leave EGR connector disconnected. D. Measurements will be made with key OFF.

Test 1	Specification
Using DMM measure voltage between Breakout Harness ZTSE4948 pin-4 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 5.
	No: Go to Test 2.

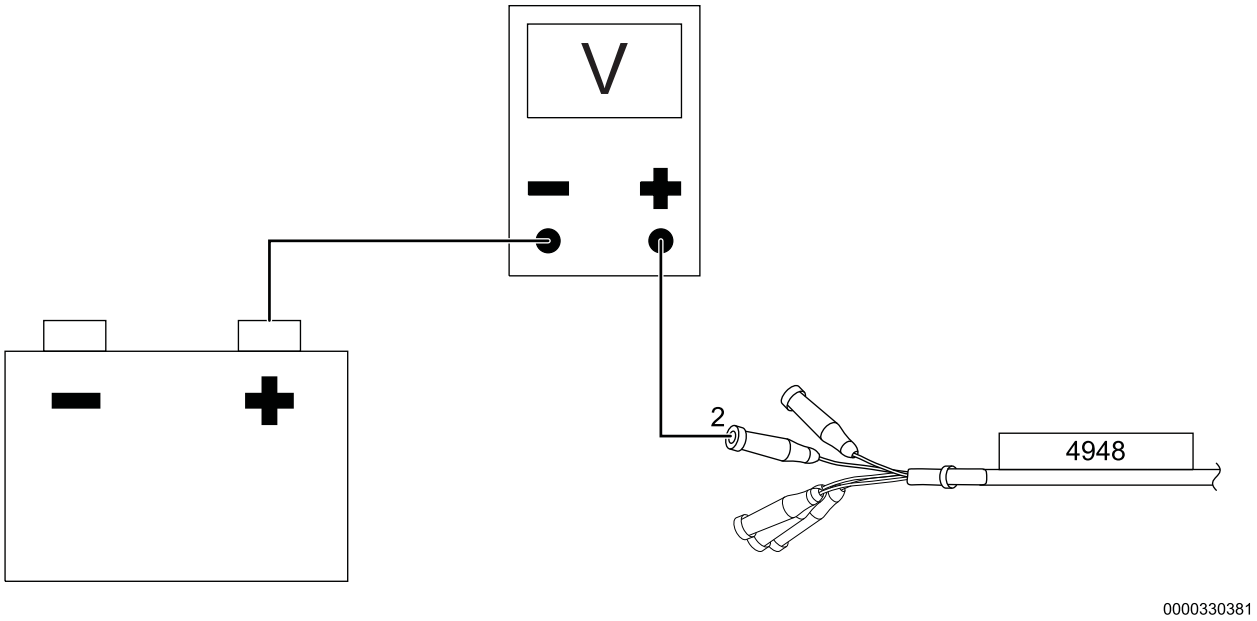


Figure 400 Test 2 Exhaust Gas Recirculation (EGR) connector Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Gas Recirculation (EGR) connector. C. Connect Breakout Harness ZTSE4948 to vehicle harness and leave EGR connector disconnected. D. Measurements will be made with key OFF.

Test 2	Specification
Using DMM measure voltage between Breakout Harness ZTSE4948 pin-2 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Short circuit to PWR in EGRVC circuit between EGR pin-2 and Engine Control Module (ECM) pin E-71. After repairs are complete, retest for SPN 2791 FMI 8.
	No: Go to Test 3.

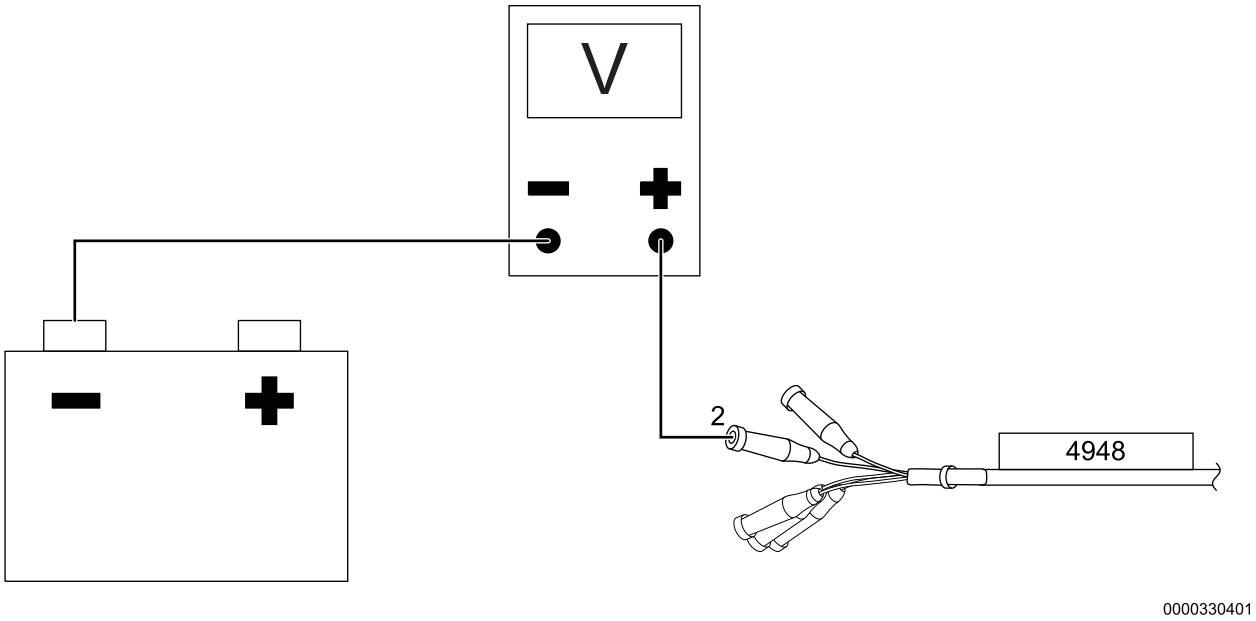


Figure 401 Test 3 Exhaust Gas Recirculation (EGR) connector Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Exhaust Gas Recirculation (EGR) connector. C. Connect Breakout Harness ZTSE4948 to vehicle harness and leave EGR connector disconnected. D. Key ON.

Test 3	Specification
Using DMM measure voltage between Breakout Harness ZTSE4948 pin-2 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Short circuit to PWR in EGRVC circuit between EGR pin-2 and Engine Control Module (ECM) pin E-71. After repairs are complete, retest for SPN 2791 FMI 8.
	No: Go to Test 4.

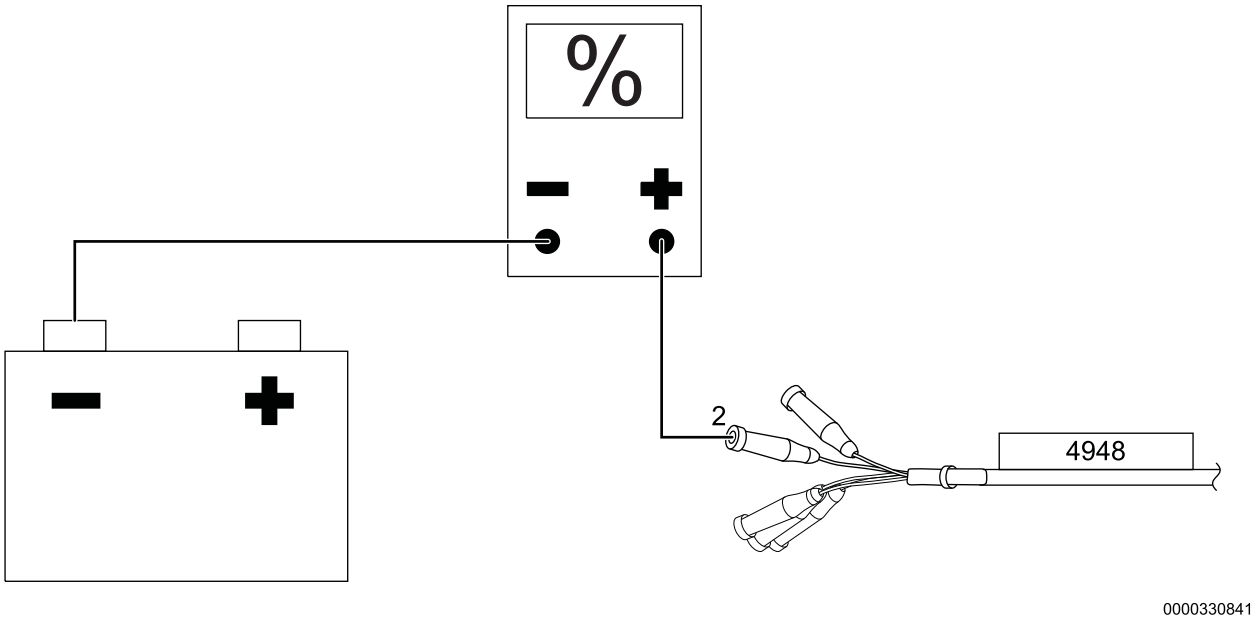


Figure 402 Test 4 Exhaust Gas Recirculation (EGR) connector % Duty Cycle

Test 4 Setup
A. Key OFF. B. Disconnect Exhaust Gas Recirculation (EGR) connector. C. Connect Breakout Harness ZTSE4948 to vehicle harness and leave EGR connector disconnected. D. Use DMM set to % duty cycle to measure duty cycle. E. Key ON.

Test 4	Specification
Using DMM measure % duty cycle between Breakout Harness ZTSE4948 pin-2 and known good GND.	Duty cycle 5 to 95%
Decision	
Is duty cycle between 5 and 95%?	Yes: Replace EGR valve. After repairs are complete, retest for SPN 2791 FMI 8.
	No: Repair Open circuit to PWR in EGRVC circuit between EGR pin-2 and Engine Control Module (ECM) pin E-71. After repairs are complete, retest for SPN 2791 FMI 8.

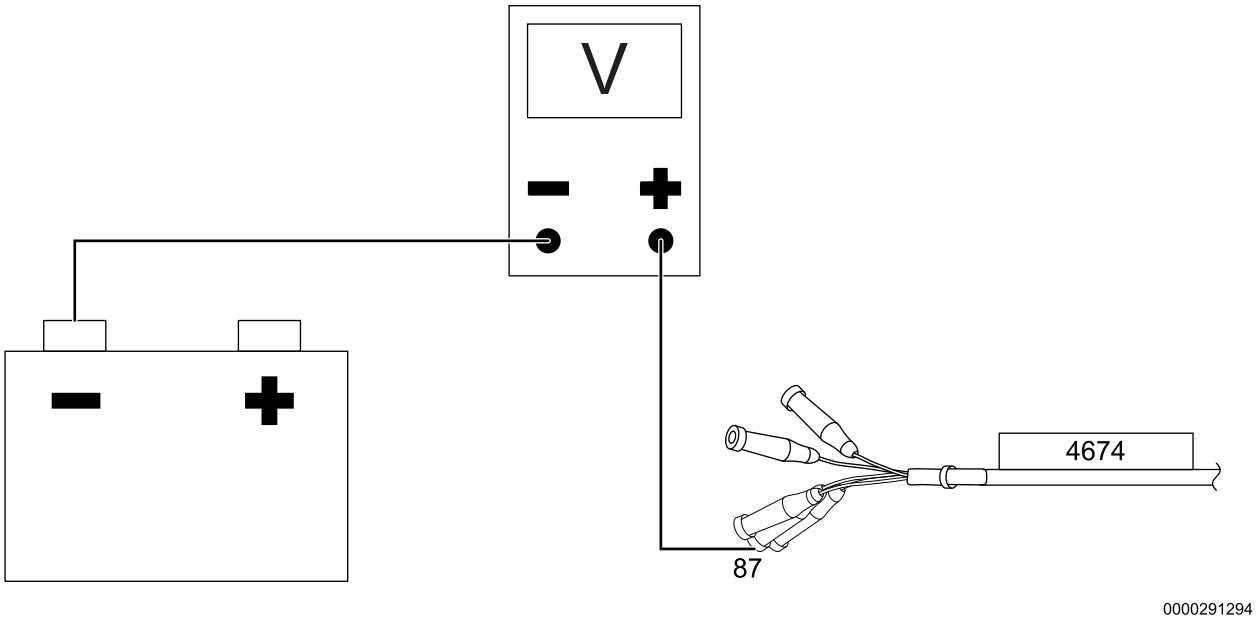


Figure 403 Test 5 ACT PWR relay connector Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Disconnect ACT PWR relay connector. C. Connect Breakout Harness ZTSE4674 to vehicle harness and leave ACT PWR relay connector disconnected. D. Key ON.

Test 5	Specification
Using DMM measure voltage between Breakout Harness ZTSE4674 pin-87 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Short circuit to PWR in ACT PWR relay circuit between ACT PWR pin-87 and EGR pin-4. After repairs are complete, retest for SPN 2791 FMI 8.
	No: Go to Test 6.

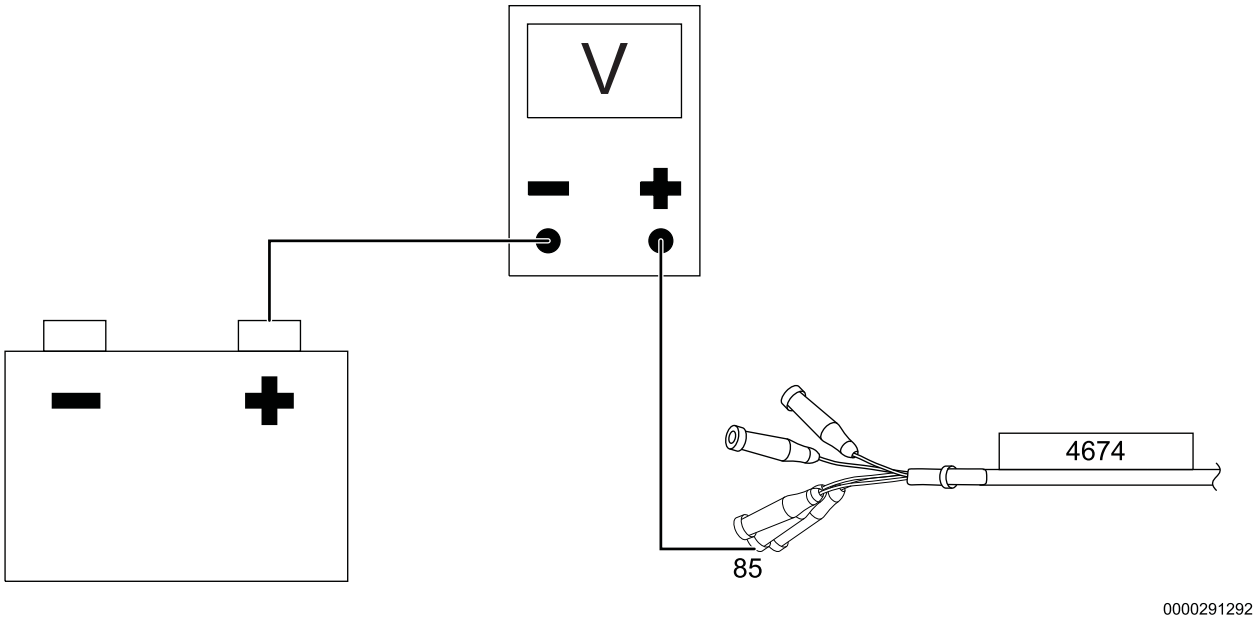


Figure 404 Test 6 ACT PWR relay connector Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Disconnect ACT PWR relay connector. C. Connect Breakout Harness ZTSE4674 to vehicle harness and leave ACT PWR relay connector disconnected. D. Measurements will be made with key OFF.

Test 6	Specification
Using DMM measure voltage between Breakout Harness ZTSE4674 pin-85 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Short circuit to GND in ACT PWR relay circuit between ACT PWR pin-85 and Engine Control Module (ECM) pin E-70. After repairs are complete, retest for SPN 2791 FMI 8.
	No: Replace ACT PWR relay. After repairs are complete, retest for SPN 2791 FMI 8.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 2791 FMI 8 fault code diagnostics.

SPN 2791 FMI 12 - EGR Valve Internal self test fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Recirculation (EGR) valve internal circuit failure	Valve seat growth has increased by 2 mm during one drive cycle	Key ON then Key OFF

Fault Overview

Fault code sets when Engine Control Module (ECM) detects seated Exhaust Gas Recirculation (EGR) valve position has increased by 2 mm during a single drive cycle.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Fault

None

Fault Facts

Exhaust Gas Recirculation (EGR) valve seat position is recorded during initial Key OFF.

Drive Cycle to Determine Fault Status

Key ON then Key OFF

Possible Causes

- Failed EGR valve

Step 1	Replace Exhaust Gas Recirculation (EGR) valve.	Decision
Replace EGR valve, using Electronic Service Tool (EST) with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.		After repairs are complete, retest for SPN 2791 FMI 12.

End Diagnostic Steps
After performing diagnostic steps, if SPN 2791 FMI 12 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 2791 FMI 14 - EGR Valve did not seat

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Recirculation (EGR) valve position sensor initialization error.	EGR valve position error during EGR valve initialization > 45 steps (approximately 30% of movement range) EGR valve control initialization time > 1.6 seconds [Current on low side motor driver > 18 Amps for > 1 second AND number of occurrences in the same key cycle event = 3 minimum time between each attempt = 1 second Voltage at each of the EGR valve motor terminals ≤ 7 volts AND number of occurrences in the same key cycle event = 3	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) determines Exhaust Gas Recirculation (EGR) valve is not functioning properly when initialized.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Fault

SPN 2791 FMI 7 (EGR valve)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed EGR valve

Step 1	Check for associated fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1108).		Yes: Go to Step 2.
Is EST DTC list free of Associated Faults?		No: Repair Associated Faults. After repairs are complete, retest for SPN 2791 FMI 14.

Step 2	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing.		Yes: Go to Step 3.
Are EGR valve connector, harness, and terminals clean and undamaged?		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2791 FMI 14.

Step 3	Test for proper Exhaust Gas Recirculation (EGR) valve operation.	Decision
Perform EGR Valve Operation Verification Test (page 2271).		Yes: Replace EGR valve. After repairs are complete, retest for SPN 2791 FMI 14.
Is SPN 2791 FMI 14 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing diagnostic steps, if SPN 2791 FMI 14 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4752 FMI 4 - EGR Cooler Efficiency: EGR Outlet Temp above expected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Exhaust Gas Recirculation Cooler effectiveness monitor	Simulated Engine Exhaust Gas Recirculation Cooler outlet temperature {Simulated Engine EGR Cooler outlet temperature is estimated based on Engine Intake Mass Air Flow, Engine Intake Manifold 1 Temperature and Engine Charge Air Cooler Outlet Gas temperature sensor} > Threshold value defined by Speed/Torque table (Table A076) * Engine Air Intake Temperature Modifier (Table A077) * Barometric Pressure Modifier (Table A078)	Particulate Filter Regeneration NOT Active SCR Warm-up NOT Active Barometric Absolute Pressure ≥ 10.7 psi (73.5 kPa) AND ≤ 14.9 psi (103 kPa) Ambient Air Temperature ≥ 19.4°F (-7°C) AND ≤ 140°F (60°C) Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Engine is NOT coasting (i.e. Throttle Cut OFF mode) Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Engine Ignition Key is in "ON" position (Key ON) Time after engine start ≥ 30 seconds Engine Coolant Temperature > 68°F (20°C) AND < 219°F (104°C) [{Engine Torque (monitoring Zone 1 called out) > 1000 N·m AND ≤ 1050 N·m AND Engine Speed (monitoring Zone 1 called out) > 2700 RPM AND < 3000 RPM AND minimum time engine has to spend in Monitoring Zone 1 called out} ≥ 3 seconds OR {Engine Torque (monitoring Zone 2 called out) > 1000 N·m AND ≤ 1050 N·m AND Engine Speed (monitoring Zone 2 called out) > 2700 RPM AND < 3000 RPM AND minimum time engine has to spend in Monitoring Zone 2 called out} ≥ 3 seconds OR {Time spent in Monitoring Zone 3 defined by (Table A111)}] ≥ 3 seconds Minimum time after engine stop verification > 0 seconds

		Engine Exhaust Gas Recirculation valve position > 38 % Engine Exhaust Gas Recirculation valve command > 15 % SPN/FMI 172/3,4, 172/2, 2630/2, 102/3,4, 102/7, 105/3,4, 105/2, 108/3,4, 110/3,4, 110/2, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 2659/20, and 102/18 are NOT Active

Fault Overview

Fault sets when the Engine Control Module (ECM) determines the EGR outlet temperature is above normal operating range.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

• SPN 110 FMI 0 and 18 (ECT1)	• SPN 110 FMI 15 and 16 (EWPS)	• SPN 111 FMI 1 and 2 (EWPS)	• SPN 1209 FMI 0 (AMS)
• SPN 2630 FMI 16 (CACOT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Plugged EGR cooler gas side
- Plugged EGR cooler coolant side
- Coolant contamination of gas side
- Low coolant level
- Failed water pump
- Stuck bypass circuit
- Excessive exhaust temperature
- Biased Charge Air Cooler Outlet Temperature (CACOT) sensor
- Biased Mass Air Flow (MAF) sensor
- Biased temperature sensor
- Restricted exhaust
- MAF sensor auto-calibration
- Incorrect MAF configuration Programmable Parameters (PP)
- Biased Intake Manifold Temperature (IMT) sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1112). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4752 FMI 4.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4752 FMI 4. Is EST DTC list SPN 4752 FMI 4 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Exhaust Gas Recirculation (EGR) valve.	Decision
A. Key OFF. B. Disconnect EGR valve connector. C. Check EGR valve and connector for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGR valve connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4752 FMI 4.

Step 4	Inspect Exhaust Gas Recirculation (EGR) cooler for leaks.	Decision
Inspect Exhaust Gas Recirculation (EGR) cooler for any external coolant or exhaust gas leaks. Are there no external leaks?		Yes: Go to Step 5. No: Repair external coolant and/or exhaust leak(s). After repairs are complete, retest for SPN 4752 FMI 4.

Step 5	Test EGR cooler integrity.	Decision
Perform EGR Cooler Inspection(page 2329). Did EGR cooler pass pressure tests?		Yes: Go to Step 6.
		No: Repair or replace EGR cooler, as required. After repairs are complete, retest for SPN 4752 FMI 4.

Step 6	Check EGR internal condition.	Decision
Refer to *Engine Service Manual*, and remove EGR cooler for inspection. Inspect EGR cooler for plugged coolant and gas passages and internal coolant and exhaust gas leaks. Is EGR cooler free of obstructions and internal leaks?		Yes: Go to Step 7.
		No: Clean, repair, or replace EGR cooler, as required. After repairs are complete, retest for SPN 4752 FMI 4.

Step 7	Perform Mass Air Flow (MAF) sensor calibration.	Decision
Perform KOER MAF Sensor Calibrations(page 2268) using Electronic Service Tool (EST) with ServiceMaxx™ software. Ensure MAF calibration requirements are met and MAF calibration pre-checks are done before doing this procedure. Did MAF sensor calibration run successfully?		Yes: Retest for SPN 4752 FMI 4.
		No: Verify all MAF calibration requirements are met and MAF calibration pre-checks are done. Repeat MAF calibration. After repairs are complete, retest for SPN 4752 FMI 4.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4752 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

EGT Sensor (Exhaust Gas Temperature)

Overview of EGT Sensor Group

SPN	FMI	Description
173	2	EGT signal erratic, intermittent, or incorrect (page 1117)
173	3	EGT signal Out of Range HIGH (page 146)
173	4	EGT signal Out of Range LOW (page 1129)

Overview

Exhaust Gas Temperature (EGT) sensor provides feedback signal to Engine Control Module (ECM) indicating exhaust gas temperature.

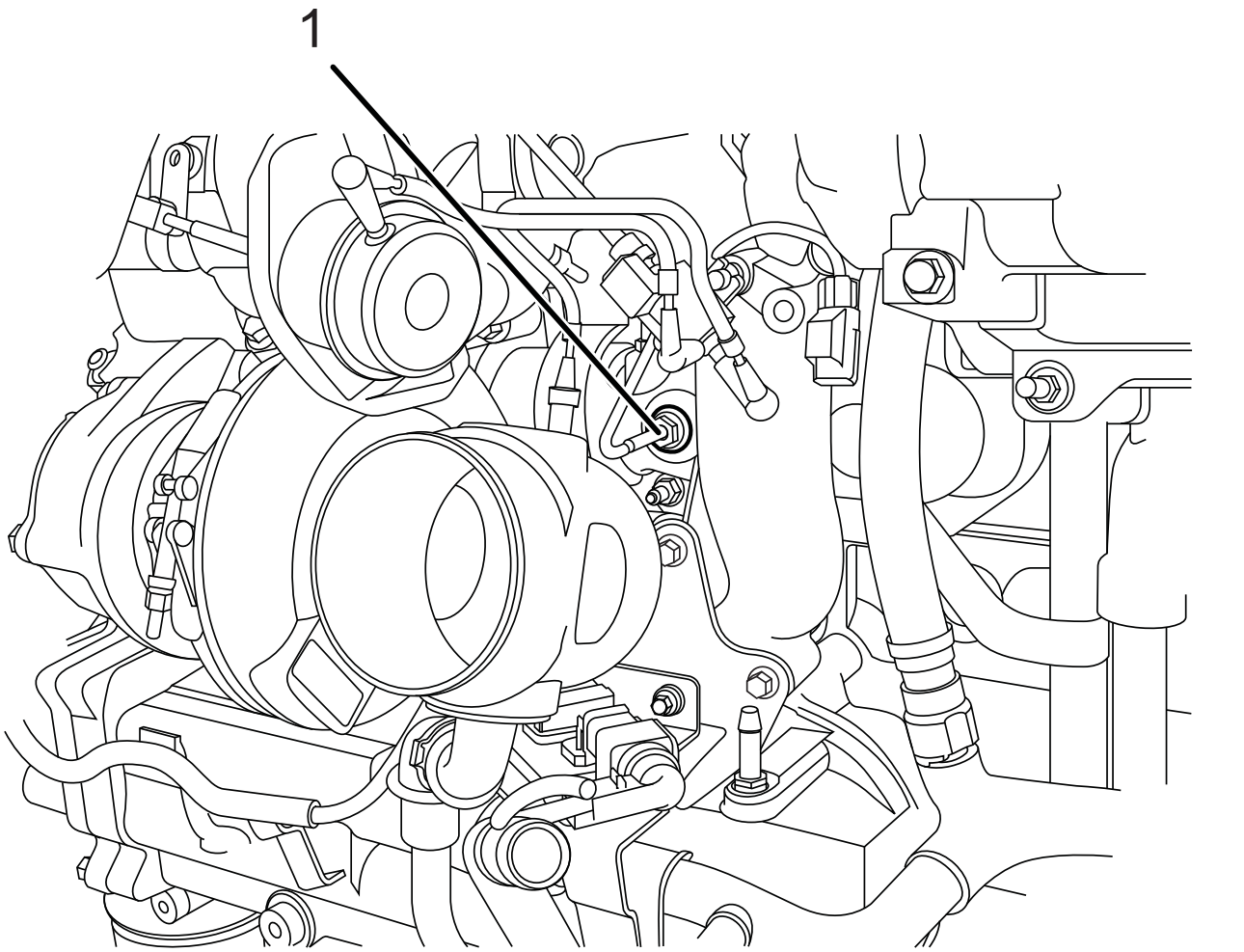


Figure 405 Exhaust Gas Temperature (EGT) Sensor Location

1. EGT sensor

SPN 173 FMI 2 - EGT signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Actual EGT does not agree with estimated value	EGT temperature compared to estimated EGT difference > 572°F (300°C)	Key ON Estimated exhaust gas temperature > 437°F (225°C)

Fault Overview

Fault sets when Engine Control Module detects difference between estimated Exhaust Gas Temperature (EGT) and actual EGT is greater than 437°F (225°C) for 25.5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 173 FMI 3 and 4 (EGT)			

Fault Facts

ECM estimates EGT based on engine speed and torque, engine coolant temperature, and barometric pressure.

Drive Cycle to Determine Fault Status

Key-On Engine-Running (KOER)

Possible Causes

- Failed EGT sensor
- High resistance in EGT circuit
- High resistance in SIG GND circuit

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1117). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 173 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 173 FMI 2. Is EST DTC list SPN 173 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Exhaust Gas Temperature (EGT) connector.	Decision
A. Key OFF. B. Disconnect EGT connector. C. Check EGT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EGT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 173 FMI 2.

Pin-Point Tests (SPN 173 FMI 2)

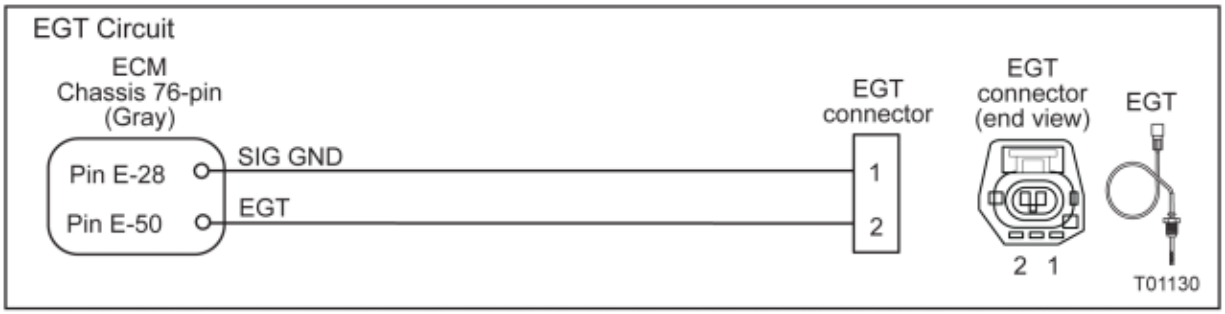
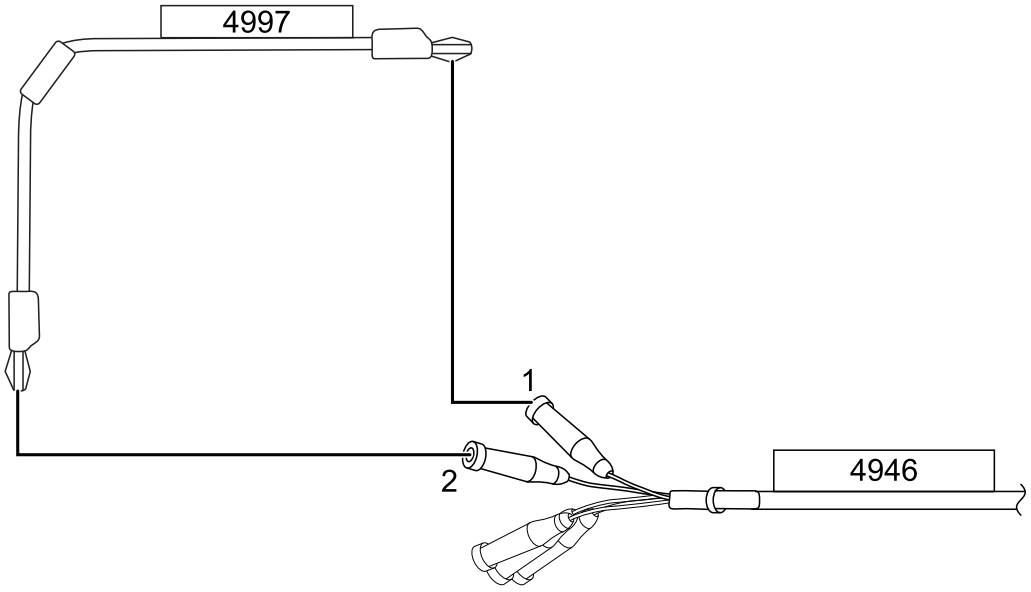


Figure 406 Exhaust Gas Temperature (EGT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4946
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



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Figure 407 Test 1 Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Gas Temperature (EGT) sensor. C. Connect Breakout Harness ZTSE4946 to vehicle harness connector and leave EGT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4946 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor exhaust gas temperature.	1020.7 ± 10°F (549.3 ± -12.2°C)
Decision	
Is temperature 1020.7 ± 10°F (549.3 ± -12.2°C)?	Yes: Replace EGT sensor. After repairs are complete, retest for SPN 173 FMI 2.
	No: Go to Test 2.

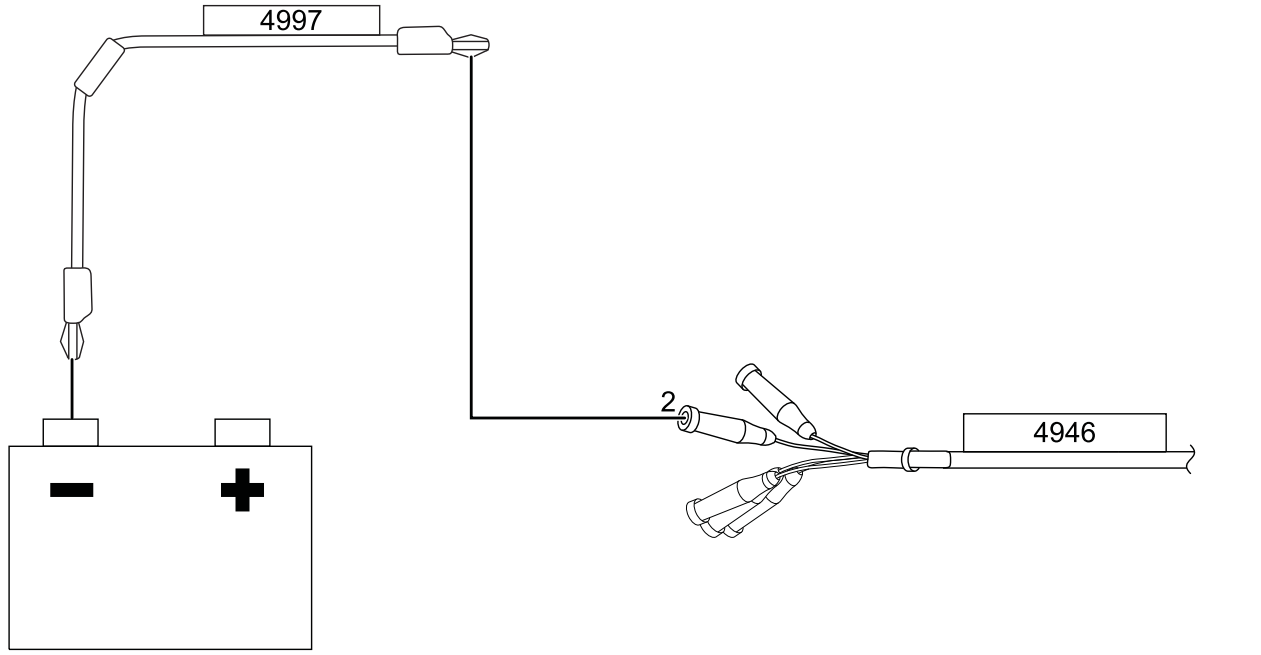


Figure 408 Test 2 IMT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Exhaust Gas Temperature (EGT) sensor. C. Connect Breakout Harness ZTSE4946 to vehicle harness connector and leave EGT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4946 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor exhaust gas temperature.	1020.7 ± 10°F (549.3 ± -12.2°C)
Decision	
Is temperature 1020.7 ± 10°F (549.3 ± -12.2°C)?	Yes: Replace SIG GND circuit between EGT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 173 FMI 2.
	No: Replace SIG circuit between EGT pin-2 and ECM pin E-50. After repairs are complete, retest for SPN 173 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 173 FMI 2 fault code diagnostics.

SPN 173 FMI 3 - EGT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Temperature (EGT) signal Out of Range High	EGT voltage > 4.8 volts	Key ON, Engine Running (KOER), and exhaust hot Estimated EGT > 437°F (225°C)

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Exhaust Gas Temperature (EGT) is above maximum threshold.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Exhaust Gas Temperature (EGT) circuit OPEN
- EGT circuit short to PWR
- SIG GND Circuit OPEN
- Failed EGT Sensor

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 173 FMI 3. Is EST DTC list SPN 173 FMI 3 Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure.

Step 2	Inspect for Exhaust Gas Temperature (EGT) sensor for damage.	Decision
A. Key OFF. B. Disconnect EGT sensor connector. C. Inspect EGT connector for: damage, pinched wires, corroded terminals, loose, bent or broken pins, or broken connector housing. Is EGT connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Tests (SPN 173 FMI 3) . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 173 FMI 3.

Pin-Point Tests (SPN 173 FMI 3)

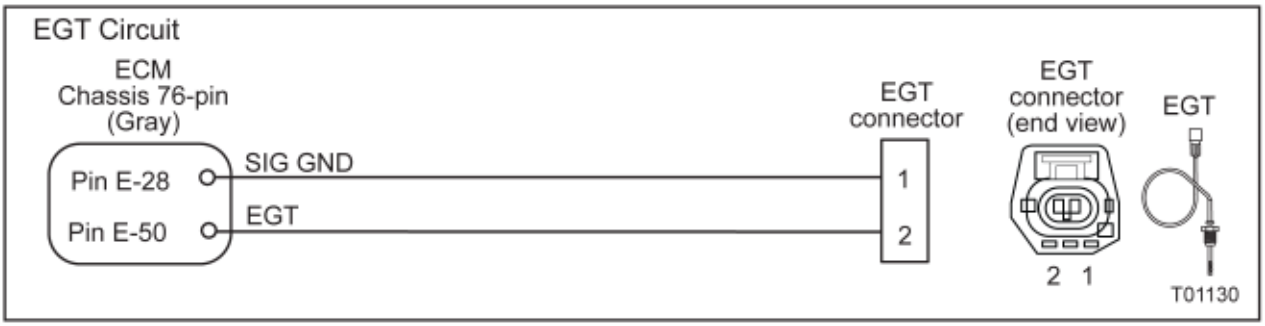


Figure 409 Exhaust Gas Temperature (EGT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Tools Required

- Breakout Harness ZTSE4498
- Breakout Harness ZTSE4946
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

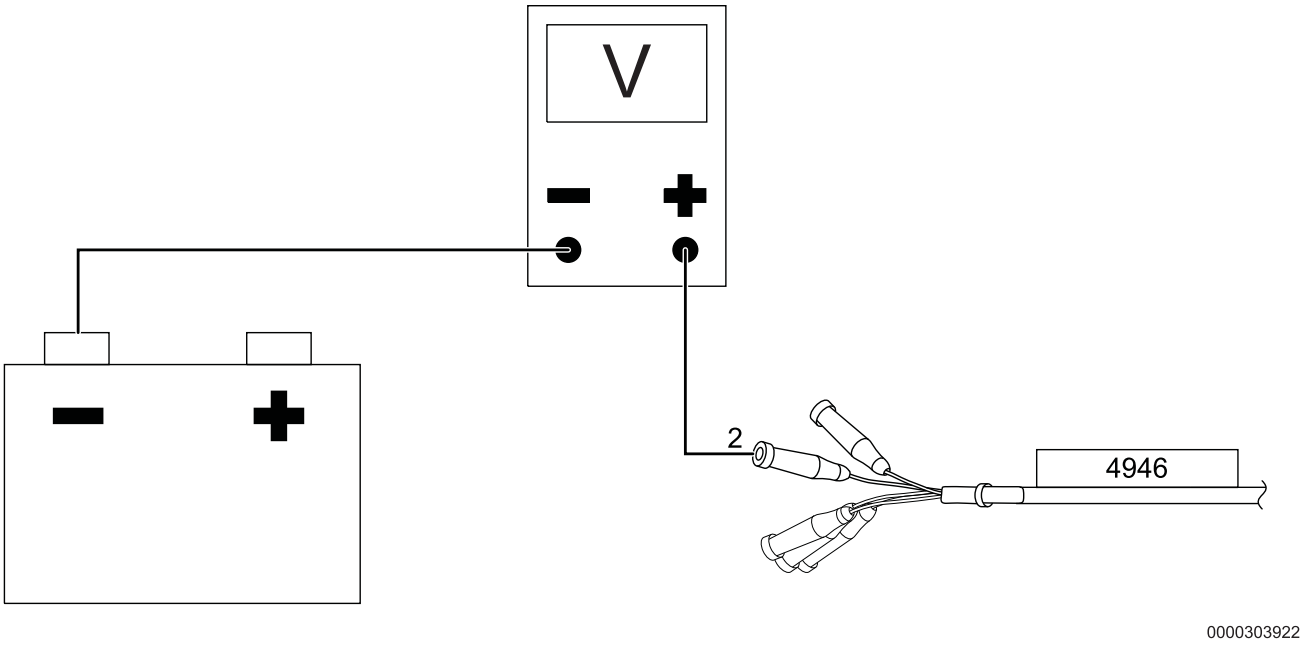
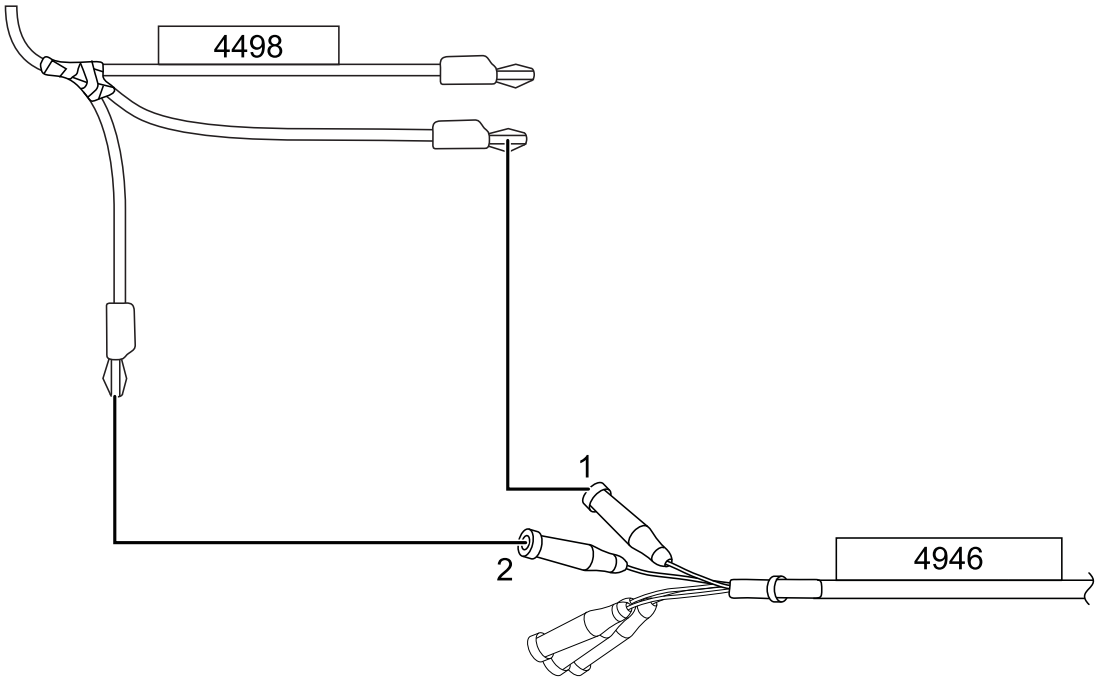


Figure 410 Test 1 Exhaust Gas Temperature (EGT) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4946 to vehicle harness and leave Exhaust Gas Temperature (EGT) sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4946 pin-2 and known good ground.	6 volts
Decision	
Is voltage greater than 6.0 volts?	Yes: Repair short to PWR between EGT pin-2 and Engine Control Module (ECM) pin E-50. After repairs are complete, retest for SPN 173 FMI 3.
	No: Go to Test 2.



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Figure 411 Test 2 Exhaust Gas Temperature (EGT) Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4946 to Exhaust Gas Temperature (EGT) sensor connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-2 of Breakout Harness ZTSE4946 together. D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software. F. Start engine. Run estimated exhaust temperature up to greater than 437°F (225°C).

Test 2	Specification
With exhaust temperature greater than 437°F (225°C), use EST with ServiceMaxx™ software to clear Diagnostic Trouble Code (DTC) list.	SPN 173 FMI 4 sets after DTC list is cleared
Decision	
Does SPN 173 FMI 4 set after DTC list is cleared?	Yes: Replace EGT sensor. After repairs are complete, retest for SPN 173 FMI 3.
	No: Go to Test 3.

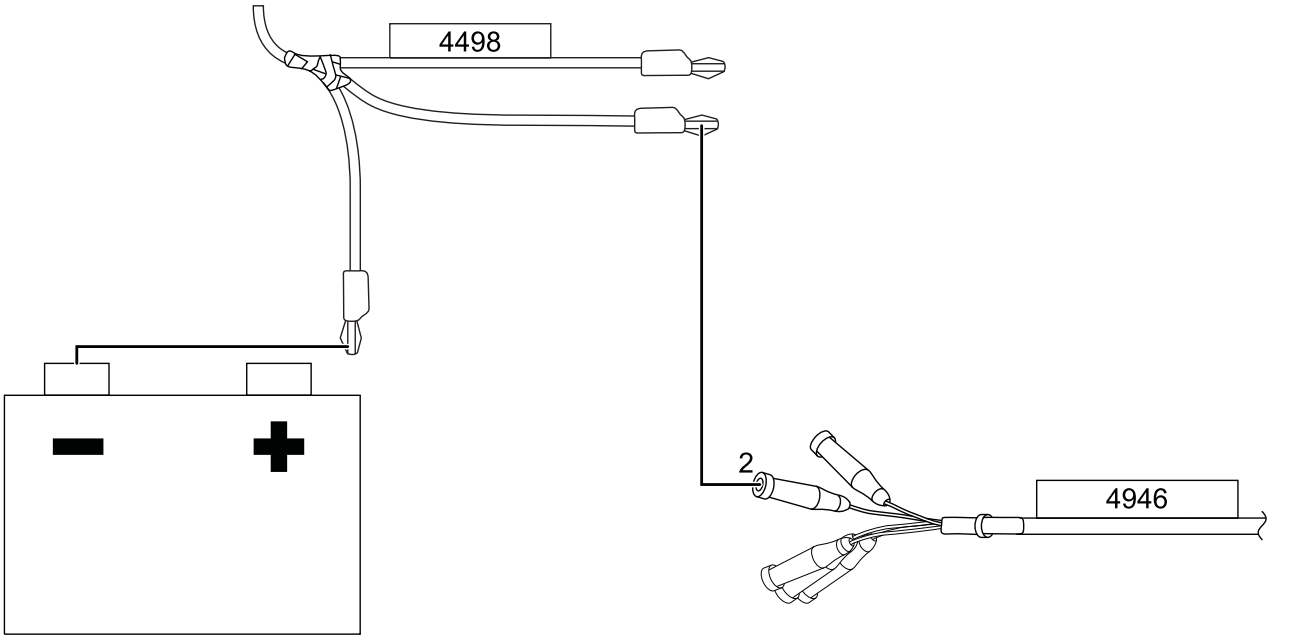


Figure 412 Test 3 Exhaust Gas Temperature (EGT) Circuit Check

Test 3 Setup
A. Key OFF.
B. Connect Breakout Harness ZTSE4946 to vehicle harness and leave EGT sensor disconnected.
C. Using Breakout Harness ZTSE4498, short pin-2 of Breakout Harness ZTSE4946 to known good ground.
D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124).
E. Key ON. Log in to ServiceMaxx™ software.
F. Start engine. Run estimated exhaust temperature up to greater than 437°F (225°C).

Test 3	Specification
With exhaust temperature greater than 437°F (225°C), use EST with ServiceMaxx™ software to clear DTC list.	SPN 174 FMI 4 sets after DTC list is cleared
Decision	
Does SPN 173 FMI 4 set after DTC list is cleared?	Yes: Repair Open between EGT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 173 FMI 3.
	No: Repair Open between EGT pin-2 and ECM pin E-50. After repairs are complete, retest for SPN 173 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 173 FMI 3 fault code diagnostics.

SPN 173 FMI 4 - EGT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Exhaust Gas Temperature (EGT) signal Out of Range Low	EGT voltage < 0.2 volts	Key-On Engine-Running (KOER) Engine Coolant Temperature (ECT) > -58°F (-50°C) Engine Speed ≥ 650 RPM Engine torque set point ≥ 20 N·m Minimum time spent in entry condition 3 and 4 ≥ 50 * 0.1 seconds

Fault Overview

Fault sets when Engine Control Module (ECM) determines Exhaust Gas Temperature (EGT) is below minimum allowable threshold for a predetermined amount of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key-On Engine-Running (KOER)

Possible Causes

- Exhaust Gas Temperature (EGT) circuit short to PWR
- Failed EGT sensor

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 173 FMI 4. Is EST DTC list SPN 173 FMI 4 Active or Pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Exhaust Gas Temperature (EGT) sensor.	Decision
A. Key OFF. B. Disconnect EGT sensor. C. Inspect EGT connector for: damage, pinched wires, corroded terminals, loose, bent or broken pins, or broken connector housing. Is EGT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 173 FMI 4.

Pin-Point Tests (SPN 173 FMI 4)

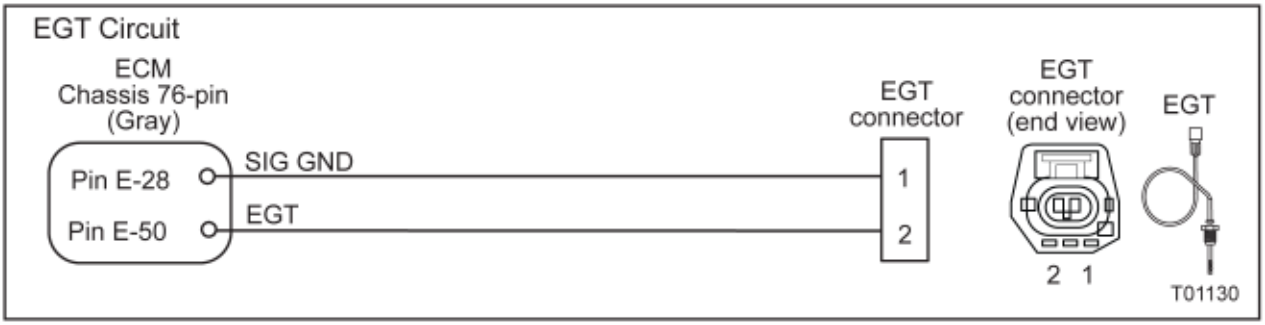


Figure 413 EGT Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Gas Temperature (EGT) sensor and leave sensor disconnected. C. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 173 FMI 3 sets after DTC list is cleared
Decision	
Does SPN 175 FMI 3 set after DTC list is cleared?	Yes: Replace EGT sensor. After repairs are complete, retest for SPN 173 FMI 4.
	No: Repair short to ground between EGT pin-2 and Engine Control Module (ECM) pin E-50. After repairs are complete, retest for SPN 173 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 173 FMI 4 fault code diagnostics.

Engine

Overview of Engine Sensor

SPN	FMI	Description
188	0	Engine Low Idle RPM above normal (page 1133)
188	1	Engine Low Idle RPM below normal (page 1135)
1322	31	Misfire - Multiple Cylinders (page 1138)
5395	0	Engine unable to achieve desired idle torque (too high) (page 1141)
5395	1	Engine unable to achieve desired idle torque (too low) (page 1145)
1323 - 1328	31	Misfire - Cylinder 1 (through 6) (page 1149)

SPN 188 FMI 0 - Engine Low Idle RPM above normal

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine idle speed is too high.	Engine speed > 104.7% of desired idle speed	Key ON Engine Coolant Temperature 1 (ECT1) between 16°F (-9°C) and 219°F (104°C) Vehicle speed < 2 mph Power Take Off (PTO) not engaged Cold Ambient Protect (CAP) OFF Engine Exhaust Brake or Vehicle Retarder NOT active Torque limiting in Limp Home Mode is NOT active Fuel cut off in engine deceleration NOT active Battery voltage > 9 volts < 16 volts SPN/FMI 636/2 and 636/7 Not Active

Fault Overview

Fault code sets when vehicle is stationary and engine speed is greater than what is requested by Engine Control Module (ECM).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 110 FMI 2 (ECT1)	• SPN 5395 FMI 0 (EWPS)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- External fuel source
- Engine oil leak to intake
- Contaminated fuel

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1133). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 188 FMI 0.

Step 2	Inspect for airborne combustibles (such as propane saturated air or ether) near engine.	Decision
Inspect air filter and intake system for stains, concentrations of contaminants, odors / smells from external fuel sources, and modifications. Is engine intake system intact and free from any external fuel sources?		Yes: Go to Step 3. No: Repair source of airborne combustibles. After repairs are complete, retest for SPN 188 FMI 0.

Step 3	Inspect for a engine oil leak to intake.	Decision
Perform Engine Oil to Intake (page 109). Is engine oil leaking to intake?		Yes: Go to Step 4. No: Repair engine oil to intake. After repairs are complete, retest for SPN 188 FMI 0.

Step 4	Inspect for contaminated fuel (alternate fuels other than diesel fuel).	Decision
Perform Fuel Quality Inspection(page 2350). Is diesel fuel in good condition and not contaminated?		Yes: Diagnostics complete. No: Drain fuel tank, and fill with clean and / or known good diesel fuel. After repairs are complete, retest for SPN 188 FMI 0.

End Diagnostic Steps
After performing diagnostic steps, if SPN 188 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 188 FMI 1 - Engine Low Idle RPM below normal

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine idle speed is too low.	Engine speed < 95.3% of desired idle speed	Key ON Engine Coolant Temperature 1 (ECT1) between 16°F (-9°C) and 219°F (104°C) Vehicle speed < 2 mph PTO not engaged Cold Ambient Protect (CAP) OFF Engine Exhaust Brake or Vehicle Retarder NOT active Torque limiting in Limp Home Mode is NOT active Fuel cut off in engine deceleration NOT active Battery voltage > 9 volts < 16 volts SPN/FMI 636/2 and 636/7 Not Active

Fault Overview

Fault code sets when vehicle is stationary and engine speed is less than what is requested by Engine Control Module (ECM).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 651 - 656 (INJ)	• SPN 1322 - 1328 FMI 31 (ENG)	• SPN 5395 FMI 1 (EWPS)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low Fuel Delivery Pressure (FDP)
- Low cylinder compression
- Clutch or Power Take Off (PTO) engagement without command

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1135). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 188 FMI 1.

Step 2	Check intake air system for restrictions, leaks, or damage.	Decision
Perform Intake Air Inspection(page 2365). Are air intake system and air filter free of restrictions, leaks, physical damage, and contamination?		Yes: Go to Step 3. No: Repair restrictions, air leaks, or physical damage. After repairs are complete, retest for SPN 188 FMI 1

Step 3	Check exhaust system for restrictions, leaks, or damage.	Decision
Perform Exhaust and Aftertreatment System Inspection(page 2368). Are exhaust and aftertreatment system free of restrictions, leaks, physical damage, and contamination?		Yes: Go to Step 4. No: Repair restrictions, leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 188 FMI 1

Step 4	Check fuel system for restrictions, leaks, or damage.	Decision
Perform Fuel System Inspection(page 2349). Are fuel system free of restrictions, leaks, physical damage, and contamination?		Yes: Go to Step 5. No: Repair restrictions, fuel leaks, or physical damage. Replace contaminated fluids as required. After repairs are complete, retest for SPN 188 FMI 1

Step 5	Check that Fuel Delivery Pressure (FDP) is within specification.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, Key-On Engine-Running (KOER) monitor FDP sensor. Is FDP within specification?		Yes: Go to Step 6. No: Go to Fuel Delivery Pressure(page 120) symptoms diagnostics. After repairs are complete, retest for SPN 188 FMI 1.

Step 6	Determine if the engine has a mechanical cylinder balance problem (compression loss).	Decision
Perform Crankcase Pressure Test.		Yes: Repair base engine compression imbalance. After repairs are complete, retest for SPN 188 FMI 1.
Does engine have excessive crankcase pressure?		No: Go to Step 7.

Step 7	Check for Power Take Off (PTO) engagement without command.	Decision
Key-On Engine-Running (KOER), monitor PTO output shaft rotation.		Yes: Repair PTO unit. After repairs are complete, retest for SPN 188 FMI 1.
Is PTO output shaft rotating without being commanded on?		No: Go to Step 8.

Step 8	Determine if engine has a fuel injector problem.	Decision
Perform KOER Cylinder Cutout Test(page 2184).		Yes: Replace injector suspected by KOER Cylinder Cutout Test(page 2184). After repairs are complete, retest for SPN 188 FMI 1.
Did one or more cylinders have significant speed difference(s) than others?		No: Go to Step 9.

Step 9	Inspect for failed valve train components.	Decision
A. Remove valve cover (see *Engine Service Manual*). B. Inspect for bent valves, fallen bridges, and valves out of adjustment.		Yes: Diagnostics complete.
Is valve train free of failed valve train components?		No: Repair failed valve train components. After repairs are complete retest for SPN 188 FMI 1.

End Diagnostic Steps
After performing diagnostic steps, if SPN 188 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 1322 FMI 31 Misfire - Multiple Cylinders

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Crankshaft acceleration indicates misfire on multiple cylinders	[Cylinder Balance Difference • Automatic Transmission; Threshold defined by Engine speed and engine oil temperature (Table A027A is for vehicle in gear and Table A112A is for vehicle in neutral) • Manual Transmission; Threshold defined by Engine speed and engine oil temperature (Table A027M is for vehicle in gear and Table A112M is for vehicle in neutral) AND Cylinder balance pi control] • Manual Transmission; Threshold defined by Engine speed and engine oil temperature (Table A028M) • Automatic Transmission; Threshold defined by Engine speed and engine oil temperature (Table A028A)	Particulate Filter Regeneration NOT Active End Of Line Testing NOT Active SCR Warm-up NOT Active Engine Coolant Temperature > -58°F (-50°C) and < 248°F (120°C) Engine Manifold Pressure < 17.4 psi (119.9 kPa) Battery Voltage ≥ 9 Volts and ≤ 16 Volts Mass fueling ≥ 0 mg/stroke and ≤ 116.7 mg/stroke Vehicle Speed ≥ 0 mph and ≤ 3.107 mph Engine Speed ≥ 650 RPM and ≤ 850 RPM Filter Stabilization Time > 10 seconds Pressure Control Valve Command < 100 % Engine Air Intake Temperature > -40°F (-40°C) AND < 212°F (100°C) Fuel Temperature > -58°F (-50°C) Engine Oil Temperature > 95°F (35°C) SPN/FMI 132/3, 132/4, 132/0, 132/1, 102/3,4, 102/7, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 175/3,4, 175/2, 164/0, 164/3,4, 3055/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 191/4, 191/3, 5395/0, 5395/1, 2659/20, 110/18, 110/17, 3055/2, 4257/7, 651/7, 652/7, 653/7, 654/7, 655/7, and 656/7 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 5395 FMI 0 Engine unable to achieve desired idle torque (too high)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Idle fuel monitor - maximum	[Idle fueling > 199 mg/stroke ≥ 60 seconds	Engine in Idle State as defined by [Table A114] Accelerator Throttle pedal position 1 command < 4.98% Vehicle Speed < 1.2 mph (2 kph) Engine Coolant temperature > 158°F (70°C) Regen NOT Active PTO NOT Active Cold ambient protection controller is not active SPN 27 FMI 14; SPN 94 FMI 3 and 4; SPN 110 FMI 2, 3, and 4; SPN 132 FMI 0, 1, 3, and 4; SPN 164 FMI 0, 3, and 4; SPN 175 FMI 2, 3, and 4; SPN 191 FMI 3 and 4; SPN 636 FMI 2 and 7; SPN 651-656 FMI 4, 5, and 7; SPN 1189 FMI 3 and 4; SPN 2659 FMI 20; SPN 2791 FMI 2, 3, 4, 7, 8, and 14; SPN 3055 FMI 2; SPN 4257 FMI 7; SPN 5395 FMI 0, 1, 3, 4, and 5 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) monitoring idle fueling is greater than 199 mg/stroke for 60 seconds or more.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 651 - 656 (INJ)	• SPN 4257 (INJ)	• SPN 1322 - 1328 FMI 31 (Engine)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Aftermarket PTO installed
- Aftermarket PTO programmed incorrectly

- PTO engaged without command
- Intake restriction
- Exhaust restriction

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1141). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5395 FMI 0.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 5395 FMI 0. Is EST DTC list SPN 5395 FMI 0 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check for Intake air restriction.	Decision
Perform Intake Air Inspection(page 2365). Is intake air restriction less than 25 in-Hg (84.7 kPa) at full load and at rated speed?		Yes: Go to Step 4. No: Repair intake air restrictions. After repairs are complete, retest for SPN 5395 FMI 0.

Step 4	Check for exhaust system restriction.	Decision
Inspect exhaust system for damage and restrictions(page 2368). Is exhaust system free of any damage or restrictions?		Yes: Go to Step 5. No: Repair exhaust damage and restrictions. After repairs are complete, retest for SPN 5395 FMI 0.

Step 5	Check for aftermarket Power Take Off (PTO).	Decision
Inspect for installation of aftermarket PTO system. Was an aftermarket PTO system installed correctly?		Yes: Go to Step 6. No: Go to Step 7.

Step 6	Check for correctly programmed Power Take Off (PTO).	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Programmable Features PP75270(page 2108). Verify aftermarket PTO system was programed correctly. Was Aftermarket PTO system programmed correctly?		Yes: Go to Step 7. No: After inspection is complete, notify supervisor with results for further action. After repairs are complete, retest for SPN 5395 FMI 0.

Step 7		Decision
Check for Power Take Off (PTO) engagement without command. Key ON Engine Running (KOER), monitor PTO output shaft rotation. Is PTO output shaft rotating without throttle?		Yes: Repair PTO unit. After repairs are complete, retest for SPN 5395 FMI 0. No: Retest for SPN 5395 FMI 0.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5395 FMI 0 fault code diagnostics.

SPN 5395 FMI 1 Engine unable to achieve desired idle torque (too low)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Idle fuel monitor - minimum	[Idle fueling < 1 mg/stroke for ≥ 60 seconds	Engine in Idle State as defined by [Table A114] Accelerator Throttle pedal position 1 command < 4.98% Vehicle Speed < 1.2 mph (2 kph) Engine Coolant temperature > 158°F (70°C) Regen NOT Active PTO NOT Active Cold ambient protection controller is not active SPN 27 FMI 14; SPN 94 FMI 3 and 4; SPN 110 FMI 2, 3, and 4; SPN 132 FMI 0, 1, 3, and 4; SPN 164 FMI 0, 3, and 4; SPN 175 FMI 2, 3, and 4; SPN 191 FMI 3 and 4; SPN 636 FMI 2 and 7; SPN 651-656 FMI 4, 5, and 7; SPN 1189 FMI 3 and 4; SPN 2659 FMI 20; SPN 2791 FMI 2, 3, 4, 7, 8, and 14; SPN 3055 FMI 2; SPN 4257 FMI 7; SPN 5395 FMI 0, 1, 3, 4, and 5 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) monitoring idle fueling is less than 1 mg/stroke for 60 seconds or more.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 651 - 656 (INJ)	• SPN 4257 (INJ)	• SPN 1322 - 1328 FMI 31 (Engine)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Contaminated fuel
- Engine oil leak to intake

- Alternate fuel source
- Engine mechanical failure

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1145). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5395 FMI 1.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 5395 FMI 1. Is EST DTC list SPN 5395 FMI 1 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check for airborne combustibles.	Decision
Inspect for airborne combustibles (ex. propane saturated air, ether, etc.) near engine. Inspect air filter and intake system for stains, concentrations of contaminants, odors / smells from external fuel sources, and modifications. Is the engine intake system intact and free from any external fuel sources?		Yes: Go to Step 4. No: Repair source of combustibles. After repairs are complete, retest for SPN 5395 FMI 1.

Step 4	Check for contaminated fuel.	Decision
Inspect for contaminated fuel (alternate fuels other than Diesel fuel). Perform Fuel Quality Inspection(page 2350). Is diesel fuel in good condition and Not contaminated?		Yes: Go to Step 5. No: Drain fuel tank, and fill with clean and / or known good diesel fuel. After repairs are complete, retest for SPN 5395 FMI 1.

Step 5	Check for oil in CAC.	Decision
Inspect high pressure turbocharger outlet piping for oil. Disconnect Charge Air Cooler (CAC) inlet to check for evidence of oil. Is CAC inlet free of engine oil?		Yes: Go to Step 6. No: Repair high pressure turbocharger. After repairs are complete, retest for SPN 5395 FMI 1.

Step 6	Check for oil in LPCAC.	Decision
Inspect low pressure turbocharger outlet piping for oil. Disconnect Low Pressure Charge Air Cooler (LPCAC) inlet for evidence of oil. Is LPCAC inlet free of engine oil?		Yes: Go to Step 7. No: Repair low pressure turbocharger. After repairs are complete, retest for SPN 5395 FMI 1.

Step 7	Check for mechanical failure.	Decision
Determine if the engine has a mechanical cylinder balance problem (compression loss). Perform Crankcase Pressure Test. Is crankcase pressure within specification?		Yes: Retest for SPN 5395 FMI 1. No: Repair base engine compression imbalance. After repairs are complete, retest for SPN 5395 FMI 1.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5395 FMI 1 fault code diagnostics.

SPN 1323 -1328 FMI 31 - Misfire - Cylinder 1 (through 6)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Crankshaft acceleration indicates misfire on single cylinders	[Cylinder Balance Difference • Automatic Transmission; Threshold defined by Engine speed and engine oil temperature (Table A029A is for vehicle in gear and Table A113A is for vehicle in neutral) • Manual Transmission; Threshold defined by Engine speed and engine oil temperature (Table A029M is for vehicle in gear and Table A113M is for vehicle in neutral) AND Cylinder balance pi control] • Automatic Transmission; Threshold defined by Engine speed and engine oil temperature (Table A030A) • For Manual Transmission; Threshold defined by Engine speed and engine oil temperature (Table A030M)	Particulate Filter Regeneration NOT Active End Of Line Testing NOT Active Engine coolant Temperature > -58°F (-50°C) AND < 248°F (120°C) Engine coolant Temperature (based on Global Disable Mask) > 68°F (20°C) AND < 219°F (104°C) Engine Manifold Pressure < 17.4 psi (119.9 kPa) Battery Voltage > 9 Volts Battery Voltage (Per Global Disable Mask) ≥ 9 Volts AND ≤ 16 Volts Mass fueling ≥ 0 mg/stroke AND ≤ 116.7 mg/stroke Vehicle Speed ≥ 0 mph AND ≤ 3.107 mph Engine Speed ≥ 650 RPM AND ≤ 850 RPM Filter Stabilization Time > 10 seconds SCR Warm-up NOT Active Power Take-off Mode NOT Active Pressure Control Valve Command < 100 % Engine Air Intake Temperature > -40°F (-40°C) AND < 212°F (100°C) Fuel Temperature > -58°F (-50°C) Engine Oil Temperature > 95°F (35°C) SPN/FMI 132/3, 132/4, 132/0, 132/1, 102/3,4, 102/7, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 175/3,4, 175/2, 164/0, 164/3,4, 3055/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 191/4, 191/3, 5395/0, 5395/1, 2659/20, 110/18, 110/17, 3055/2, 4257/7, 651/7, 652/7, 653/7, 654/7, 655/7, and 656/7 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

EOP Sensor (Engine Oil Pressure)

Overview of EOP Sensor Group

SPN	FMI	Description
100	3	EOP signal Out of Range HIGH (page 1153)
100	4	EOP signal Out of Range LOW (page 1157)

Overview

Engine Oil Pressure (EOP) sensor provides feedback signal to Engine Control Module (ECM) indicating engine oil pressure. During engine operation, ECM will monitor EOP signal to determine if oil pressure is satisfactory. If oil pressure is below desired pressure, ECM will turn on red engine lamp.

An optional feature, Engine Warning and Protection System (EWPS), can be enabled to warn engine operator and shut engine down when low engine oil pressure condition occurs.

SPN 100 FMI 3 - EOP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Engine Oil Pressure (EOP) signal Out of Range HIGH	None	None

Fault Overview

None

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EOP circuit short to PWR
- SIG GND circuit Open
- Failed EOP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1153). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 100 FMI 3.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 100 FMI 3. Does EST DTC list show SPN 100 FMI 3 as Active or Pending?		Yes: Go to Step 3. Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, retest for SPN 100 FMI 3.

Step 3	Inspect connections at Engine Oil Pressure (EOP) sensor.	Decision
A. Key OFF. B. Disconnect EOP sensor connector. C. Check EOP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOP sensor connector, harness, and terminal clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 100 FMI 3.

Step 4	Inspect connections at Engine Oil Pressure (EOP) sensor.	Decision
A. Key OFF. B. Disconnect EOP sensor connector. C. Check EOP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Does SPN 100 FMI 3 set after DTC list is cleared?		Yes: Repair short to PWR between EOP sensor pin-3 and Engine Control Module (ECM) pin E-13. After repairs are complete, retest for SPN 100 FMI 3. No: Perform Pin-Point Tests .

Pin-Point Tests (SPN 100 FMI 3)

EOP Circuit

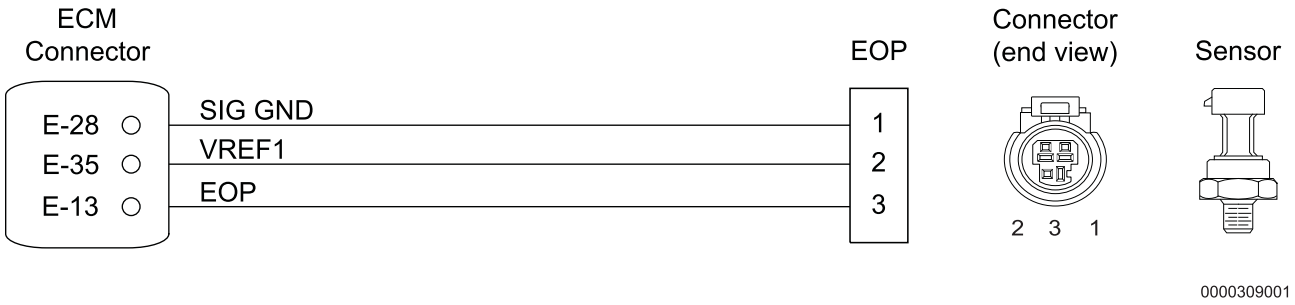


Figure 416 Engine Oil Pressure (EOP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Digital Multimeter (DMM)

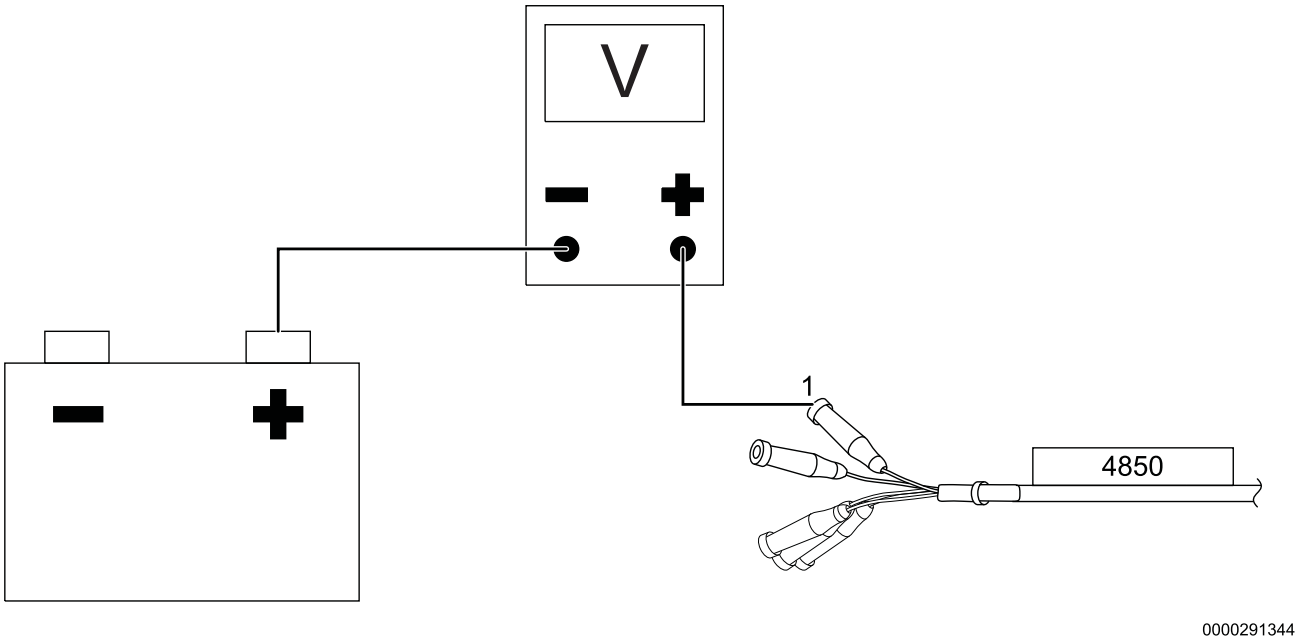


Figure 417 Test 1 Engine Oil Pressure (EOP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Engine Oil Pressure (EOP) sensor vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Using DMM measure voltage between Breakout Harness ZTSE4850 pin-1 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts.	Yes: Replace EOP sensor. After repairs are complete, retest for SPN 100 FMI 3.
	No: Repair Open between EOP sensor pin-1 and Engine Control Module (ECM) pin E-28. After repairs are complete, retest for SPN 100 FMI 3

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 100 FMI 3 fault code diagnostics.

SPN 100 FMI 4 - EOP Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Oil Pressure (EOP) signal Out of Range LOW.	None	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Engine Oil Pressure (EOP) signal is out of range low.

Lamp Reaction

None

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EOP circuit Open
- EOP circuit short to GND
- VREF1 circuit Open
- Failed EOP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1157). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 100 FMI 4.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 100 FMI 4. Is EST DTC list SPN 100 FMI 4 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, retest for SPN 100 FMI 4.

Step 3	Inspect connections at Engine Oil Pressure (EOP) sensor.	Decision
A. Key OFF. B. Disconnect EOP sensor connector. C. Check EOP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 100 FMI 4.

Pin-Point Tests (SPN 100 FMI 4)

EOP Circuit

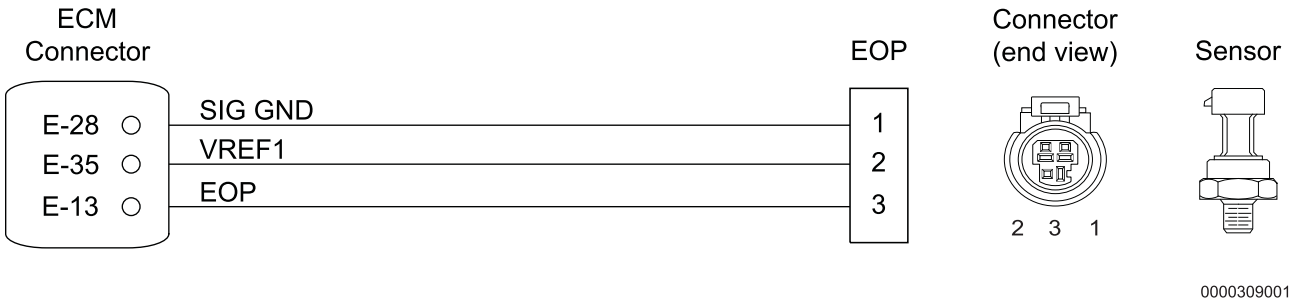


Figure 418 Engine Oil Pressure (EOP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- 3-Banana Plug Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

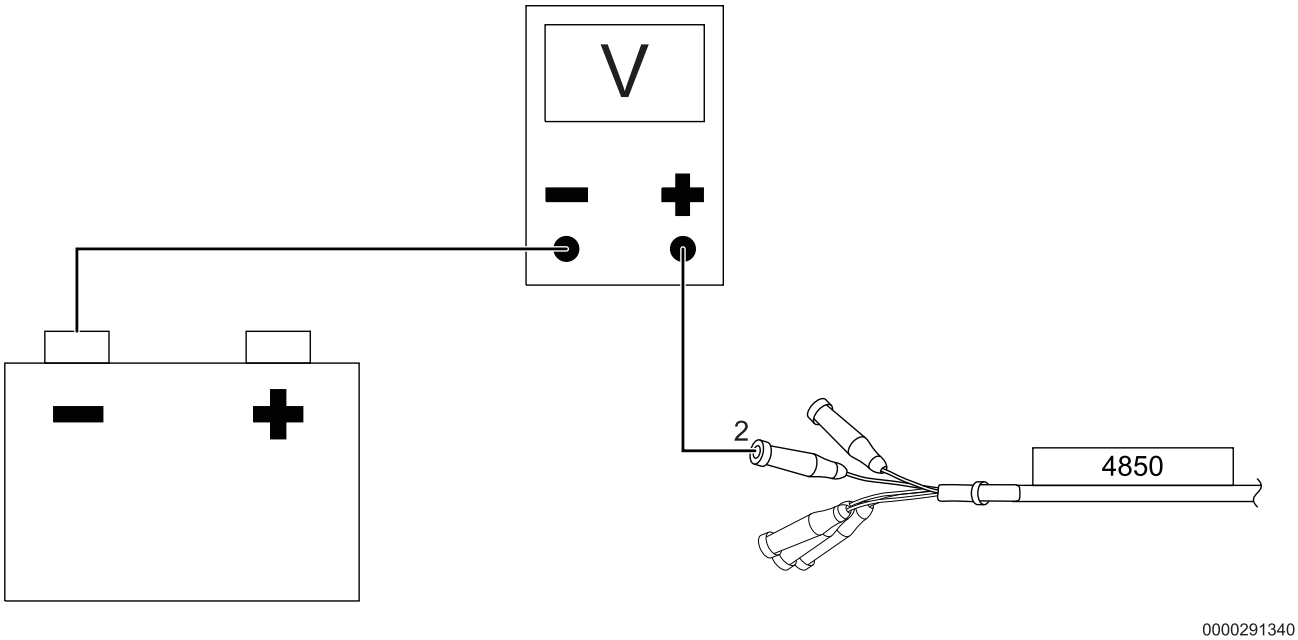
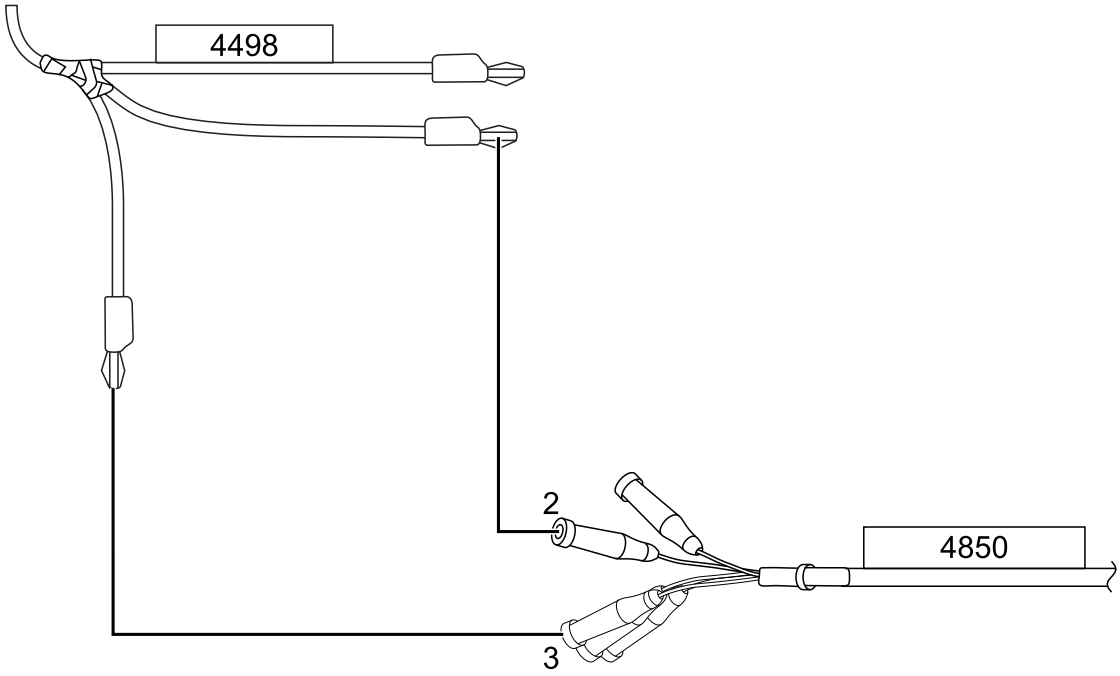


Figure 419 Test 1 VREF1 Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave Engine Oil Pressure (EOP) sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.	5 volts ± 1 volt
Decision	
Is voltage 5 volts ± 1 volt?	Yes: Go to Test 2.
	No: Repair Open between EOP pin-2 and Engine Control Module (ECM) pin E-35. After repairs are complete, retest for SPN 100 FMI 4.

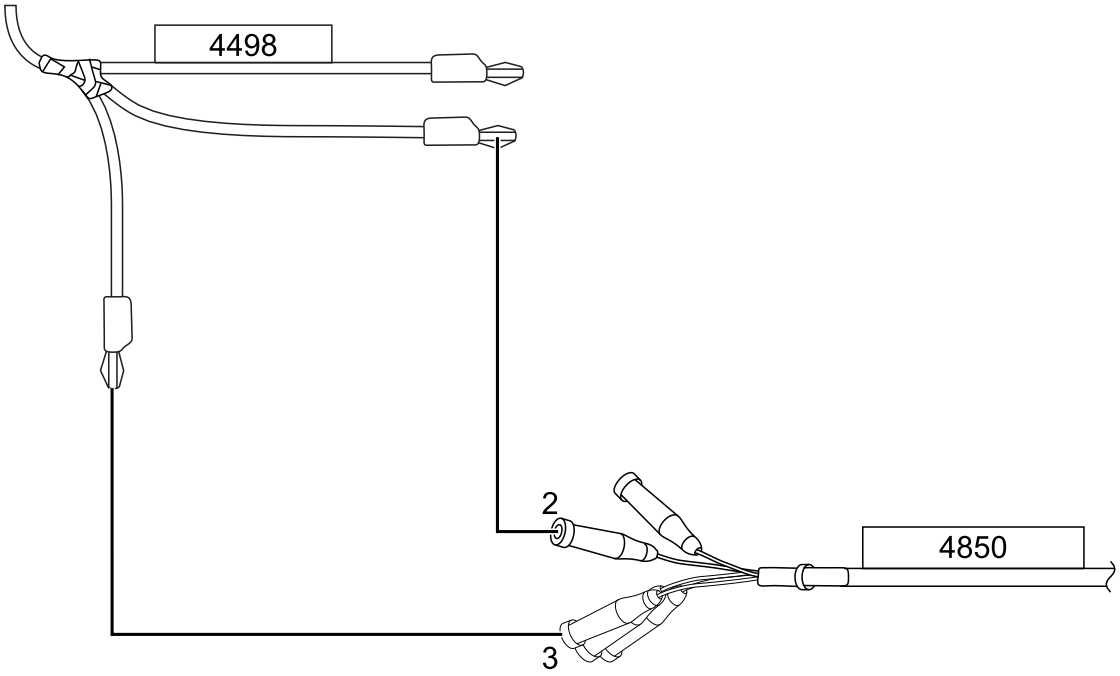


0000304541

Figure 420 Test 2 EOP Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave EOP sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 100 FMI 3 sets in DTC list.
Decision	
Does SPN 100 FMI 3 set after DTC list is cleared?	Yes: Replace EOP sensor. After repairs are complete, retest for SPN 100 FMI 4.
	No: Go to Test 3



0000304541

Figure 421 Test 3 EOP Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to vehicle harness and leave EOP sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect EST to vehicle Diagnostic Connector. E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3509 FMI 4 sets in DTC list.
Decision	
Does SPN 3509 FMI 4 set after DTC list is cleared?	Yes: Repair short to GND between EOP pin-3 and ECM pin E-13. After repairs are complete, retest for SPN 100 FMI 4.
	No: Repair Open between EOP pin-3 and ECM pin E-13. After repairs are complete, retest for SPN 100 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 100 FMI 4 fault code diagnostics.

EOT Sensor (Engine Oil Temperature)

Overview of EOT Sensor Group

SPN	FMI	Description
175	2	EOT signal erratic, intermittent, or incorrect (page 1165)
175	3	EOT signal Out of Range HIGH (page 1170)
175	4	EOT signal Out of Range LOW (page 1177)
175	7	EOT not warming along with engine (page 1181)

Overview

Engine Oil Temperature (EOT) sensor provides feedback signal to Engine Control Module (ECM) indicating engine oil temperature. ECM monitors EOT signal to control fuel quantity and timing throughout operating range of engine. EOT signal allows ECM to compensate for oil viscosity variations due to temperature changes in operating environment, ensuring adequate power and torque are available for all operating conditions.

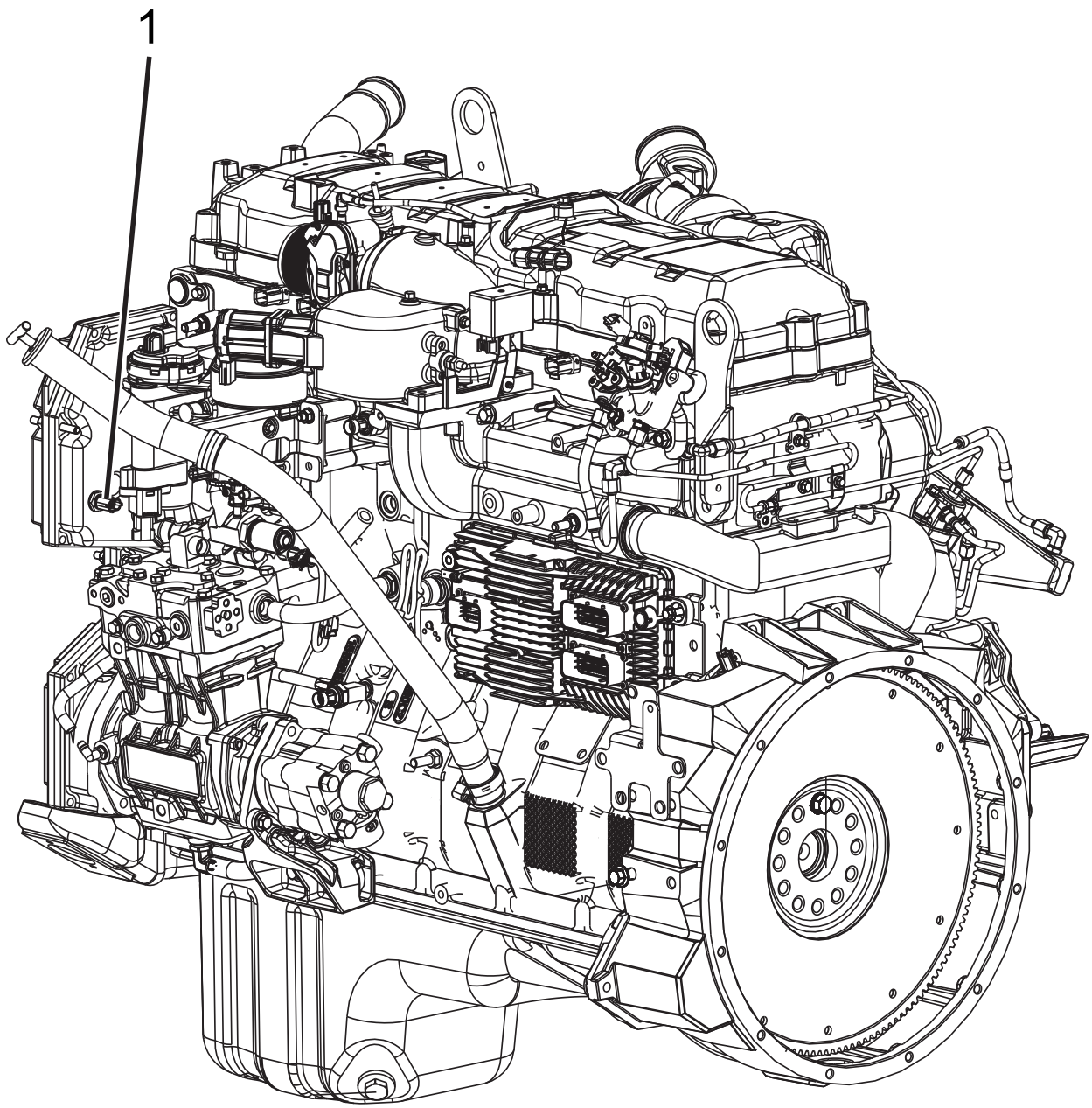


Figure 422 EOT Sensor Location

1. Engine Oil Temperature (EOT) sensor

SPN 175 FMI 2 - EOT signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Oil Temperature (EOT) does not agree with other sensors	Difference between EOT sensor and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, CACOT, TC2CIT, IMT, IAT are all within 59°F (15°C) of each other

Fault Overview

ECM Compares Engine Oil Temperature (EOT) sensor to Intake Manifold Temperature (IMT), Intake Air Temperature (IAT), Turbocharger 2 Compressor Intake Temperature (TC2CIT), Charge Air Cooler Outlet Temperature (CACOT), and Engine Coolant Temperature 1 (ECT1) sensors at Key-On after a cold soak.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 175 FMI 3 and 4 (EOT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (After Cold Soak)

Possible Causes

- Failed EOT sensor
- High resistance in ECT1 circuit
- High resistance in SIG GND circuit

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1165). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 175 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 175 FMI 2. Is EST DTC list SPN 175 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Engine Oil Temperature (EOT) connector.	Decision
A. Key OFF. B. Disconnect EOT connector. C. Check EOT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 175 FMI 2.

Pin-Point Tests (SPN 175 FMI 2)

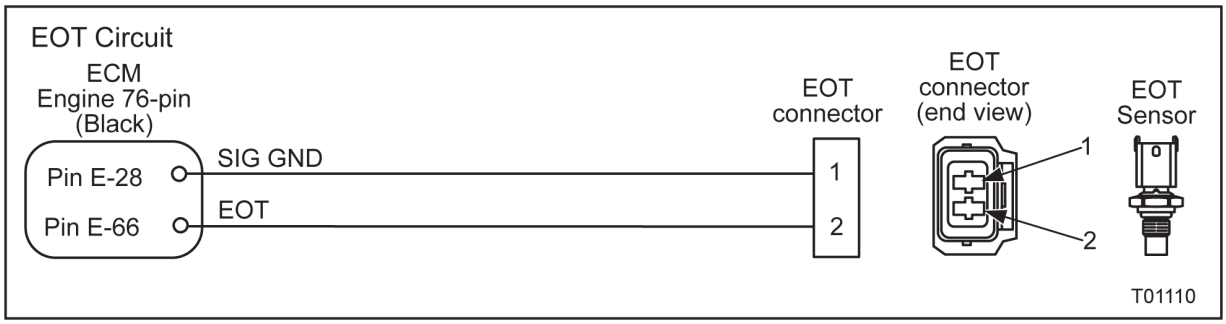
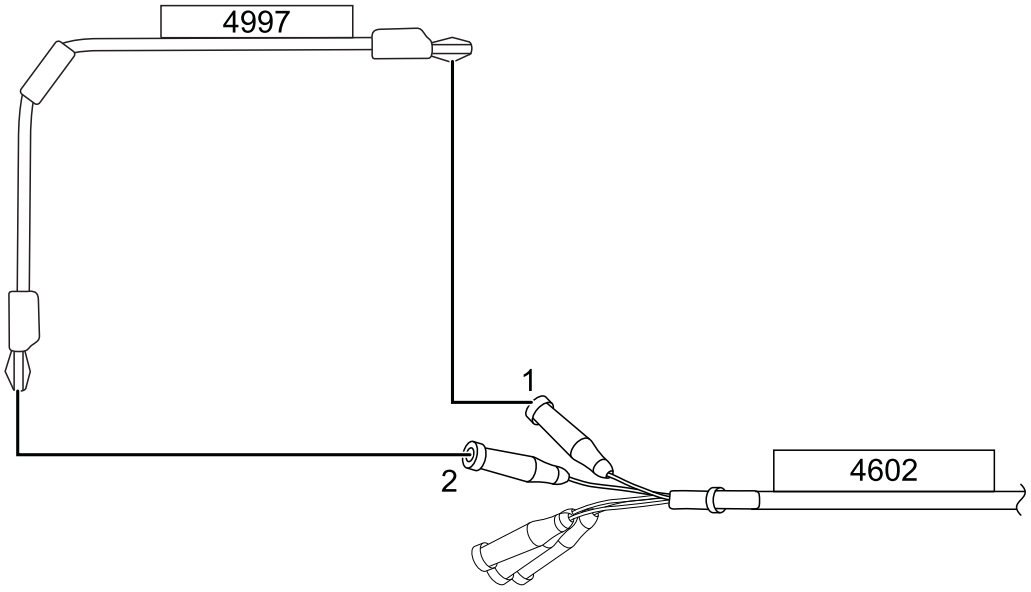


Figure 423 Engine Oil Temperature (EOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334621

Figure 424 Test 1 EOT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Replace EOT sensor. After repairs are complete, retest for SPN 175 FMI 2.
	No: Go to Test 2.

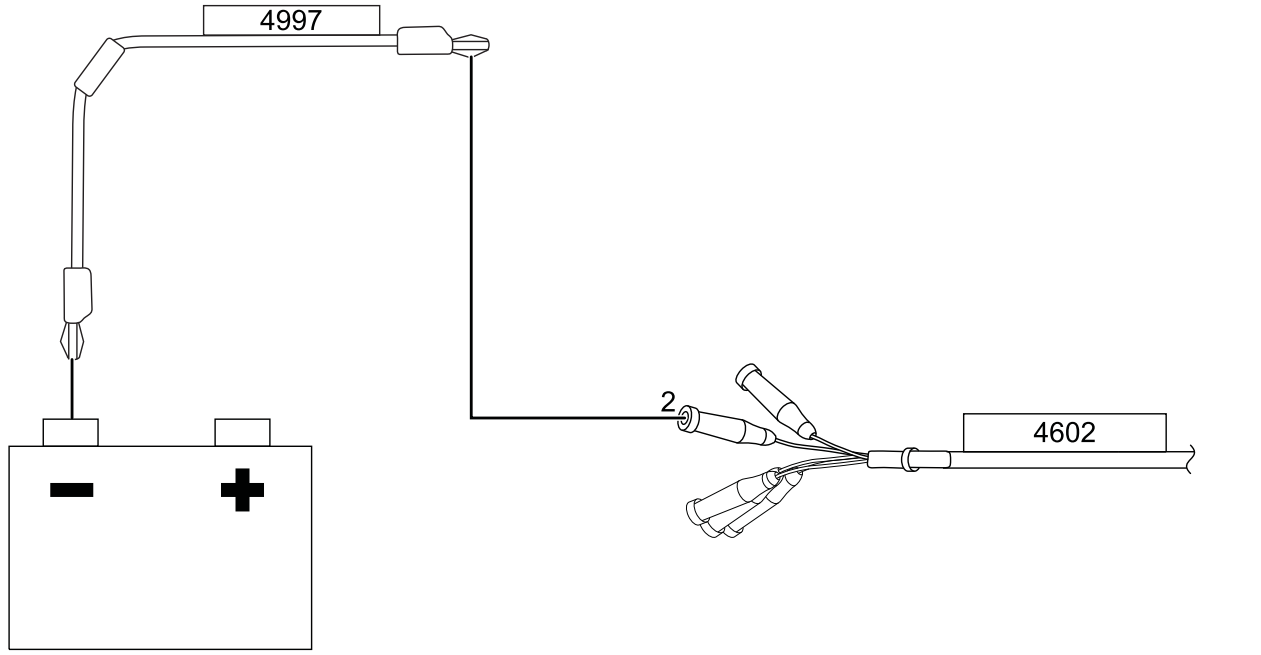


Figure 425 Test 2 EOT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Replace SIG GND circuit between EOT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 175 FMI 2.
	No: Replace SIG circuit between EOT pin-2 and ECM pin E-66. After repairs are complete, retest for SPN 175 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 175 FMI 2 fault code diagnostics.

SPN 175 FMI 3 - EOT signal Out of Range HIGH

Condition/Description	Setting Criteria	Enable Conditions / Values
Engine Oil Temperature 1 Sensor signal Out of Range High	Engine Oil Temperature 1 Sensor Voltage > 4.8 Volts (< -41°F [-40.58°C])	Key ON

Fault Overview

None

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Engine Oil Temperature (EOT) sensor signal circuit open or short to power
- EOT sensor signal circuit open
- EOT sensor ground circuit OPEN or high resistance
- Failed EOT sensor

WARNING: To prevent personal injury or death, be careful to avoid rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) from ServiceMaxx™ software, check for active fault codes SPN 175 FMI 3. Is EST DTC list SPN 175 FMI 3 active or pending?		Yes: Go to Step 2. No: Drive vehicle and retest for SPN 175 FMI 3. If fault code does not return, notify supervisor for further action.

Step 2	Inspect connections at Engine Oil Temperature (EOT) sensor.	Decision
A. Key-On Engine-Off (KOEO) B. Disconnect EOT sensor connector. C. Check EOT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOT sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 175 FMI 3.

Pin-Point Tests (SPN 175 FMI 3)

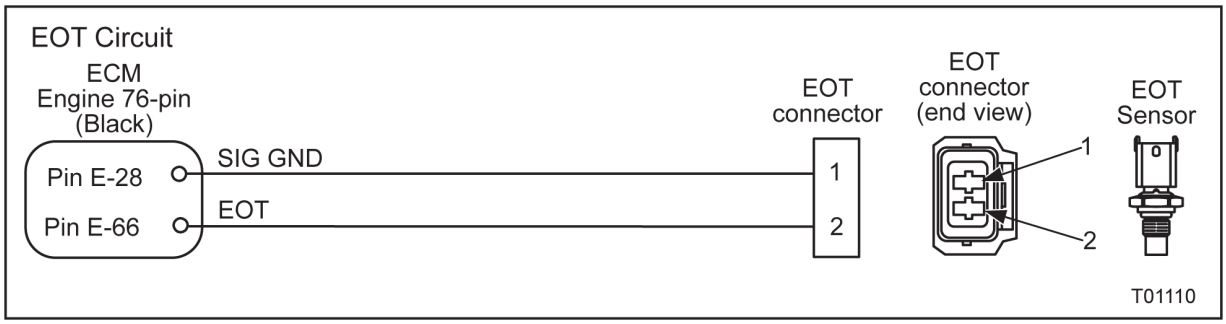


Figure 426 Engine Oil Temperature (EOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- 180-pin Breakout Box

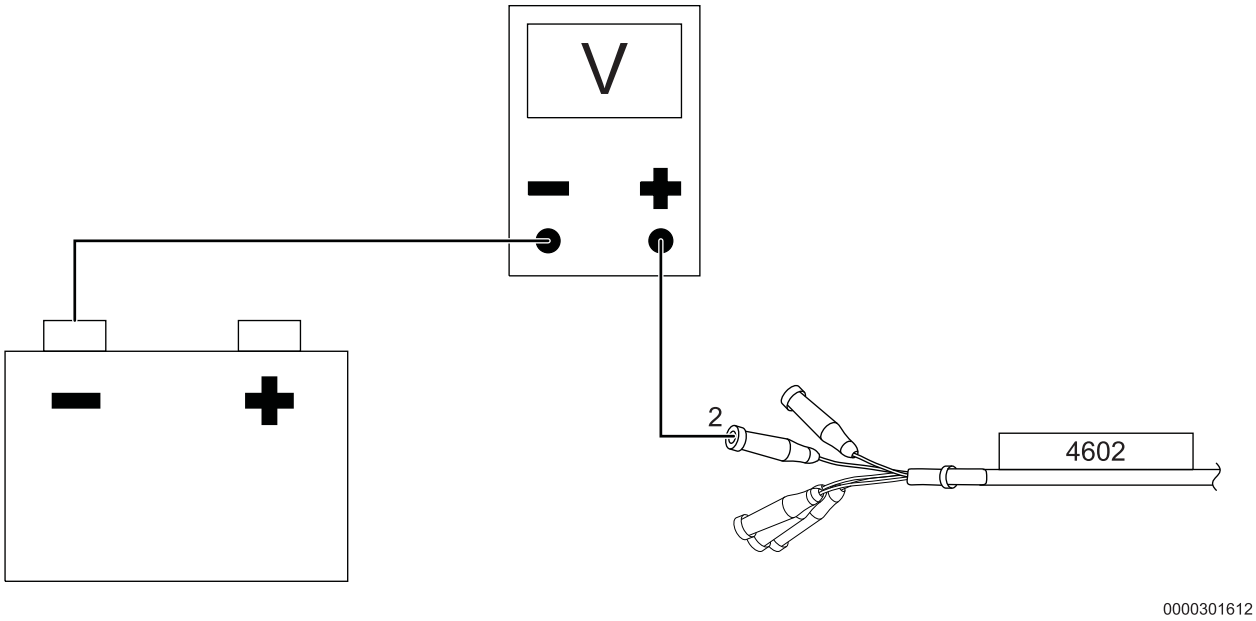


Figure 427 Test 1 Engine Oil Temperature (EOT) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4602 to Engine Oil Temperature (EOT) vehicle harness connector and leave EOT sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4602 pin-2 and known good ground.	6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair EOT circuit for a short to power. After repairs are complete, retest for SPN 175 FMI 3.
	No: Go to Test 2.

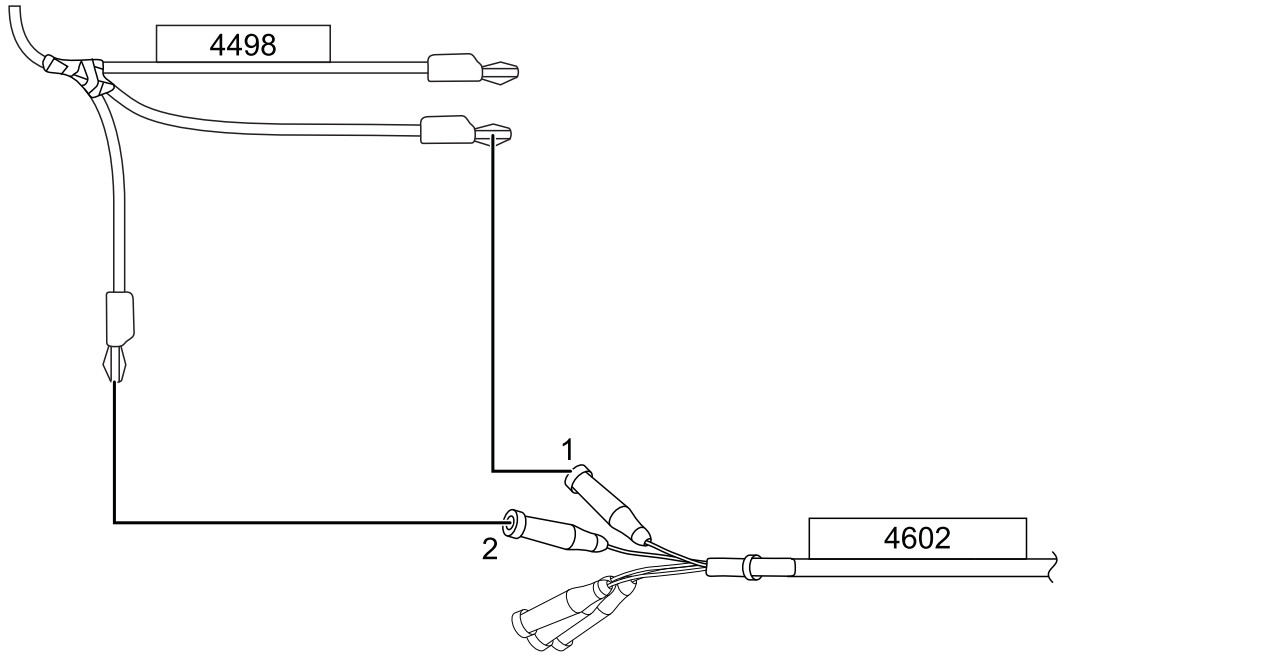
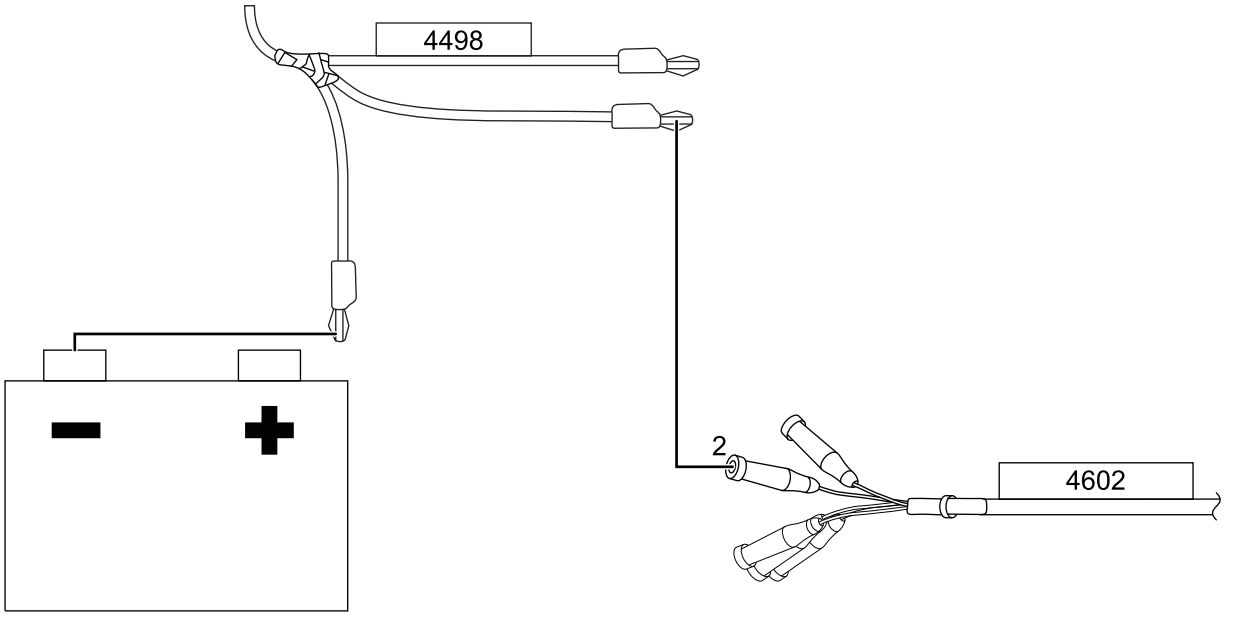


Figure 428 Test 2 Engine Oil Temperature (EOT) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4602 to Engine Oil Temperature (EOT) vehicle harness connector and leave EOT sensor disconnected. Use Breakout Harness ZTSE4498 to short pin-1 to pin-2. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON and log into ServiceMaxx™ software.

Test 2	Specification
Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	None
Decision	
Is fault code SPN 175 FMI 4 active or pending?	Yes: Replace sensor. After repairs are complete, retest for SPN 175 FMI 3.
	No: Go to Test 3.



Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4498 to Engine Oil Temperature (EOT) sensor harness connector and short pin-2 to ground. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON and log into ServiceMaxx™ software.

Test 3	Specification
Using Electronic Service Tool (EST) with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	None
Decision	
Is fault code SPN 175 FMI 4 active or pending?	Yes: Repair open in signal ground circuit. After repairs are complete, retest for SPN 175 FMI 3.
	No: Repair open in signal circuit. After repairs are complete, retest for SPN 175 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 175 FMI 3 fault code diagnostics.

SPN 175 FMI 4 - EOT signal Out of Range LOW

Condition/Description	Setting Criteria	Enable Conditions / Values
Engine Oil Temperature (EOT) sensor signal Out of Range Low	EOT sensor voltage < 0.171 Volts (> 161.9 °C)	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Engine Oil Temperature (EOT) signal is lower than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- EOT circuit short to GND
- Failed EOT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 175 FMI 4. Does EST DTC list show SPN 175 FMI 4 as active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Engine Oil Temperature (EOT) sensor.	Decision
A. Key OFF. B. Disconnect EOT sensor. C. Inspect EOT sensor and connector terminals for: damaged or pinched wire; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the EOT sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Pin-Point Test . No: Repair or Replace connector or pins. After repairs are complete, retest for SPN 175 FMI 4.

Pin-Point Tests (SPN 175 FMI 4)

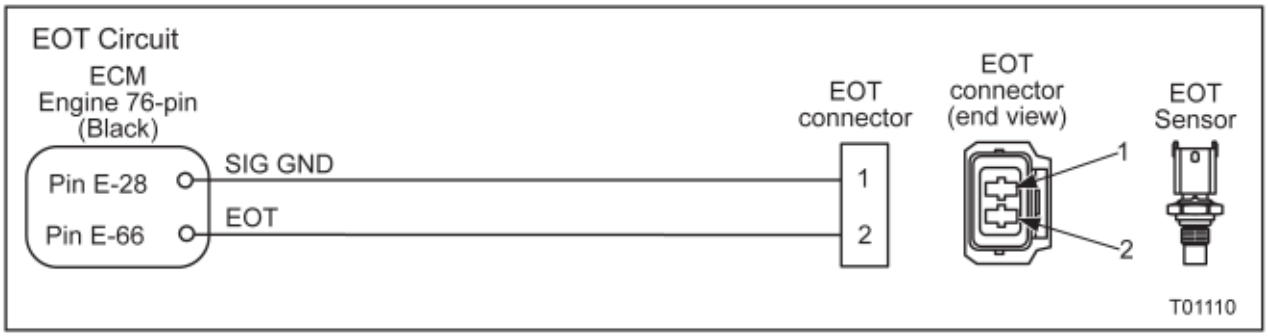


Figure 430 EOT Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Breakout Harness ZTSE4498

Test 1 Setup
A. Key OFF. B. Disconnect EOT sensor. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1 EOT Resistance Check for short to GND	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	DTC list SPN 175 FMI 3 sets
Decision	
Does SPN 175 FMI 3 set after DTC list is cleared?	Yes: Replace EOT sensor. After repairs are complete, retest for SPN 175 FMI 4.
	No: Repair short to GND between EOT pin-2 and ECM pin E-66. After repairs are complete, retest for SPN 175 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 175 FMI 4 fault code diagnostics.

SPN 175 FMI 7 - EOT not warming along with engine

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
EOT not warming along with engine	Difference between EOT sensor and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, CACOT, TC2CIT, IMT, IAT are all within 59°F (15°C) of each other

Fault Overview

ECM Compares Engine Oil Temperature (EOT) sensor to Intake Manifold Temperature (IMT), Intake Air Temperature (IAT), Turbocharger 2 Compressor Intake Temperature (TC2CIT), Charge Air Cooler Outlet Temperature (CACOT), and Engine Coolant Temperature 1 (ECT1) sensors at Key-On after a cold soak.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- High resistance EOT circuit
- High resistance SIG GND circuit
- Failed EOT sensor
- Failed oil system module thermal valve assembly

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 175 FMI 7. Is EST DTC list SPN 175 FMI 7 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Engine Oil Temperature (EOT) connector.	Decision
A. Key OFF. B. Disconnect EOT connector. C. Check EOT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 175 FMI 7.

Pin-Point Tests (SPN 175 FMI 7)

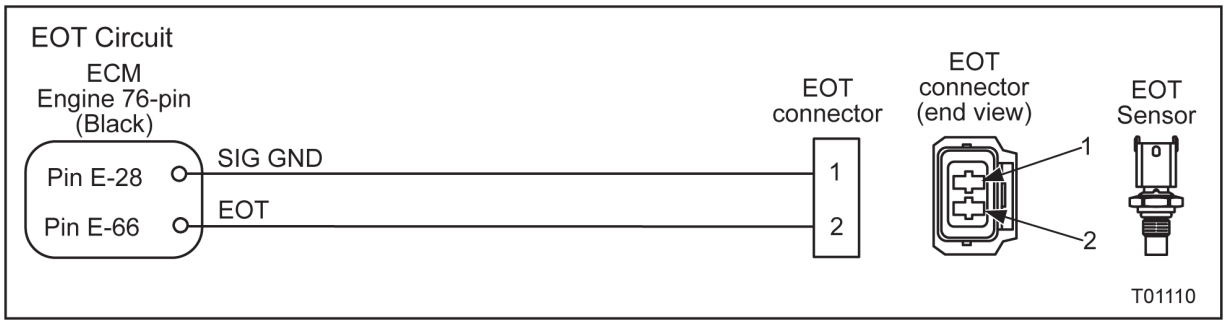
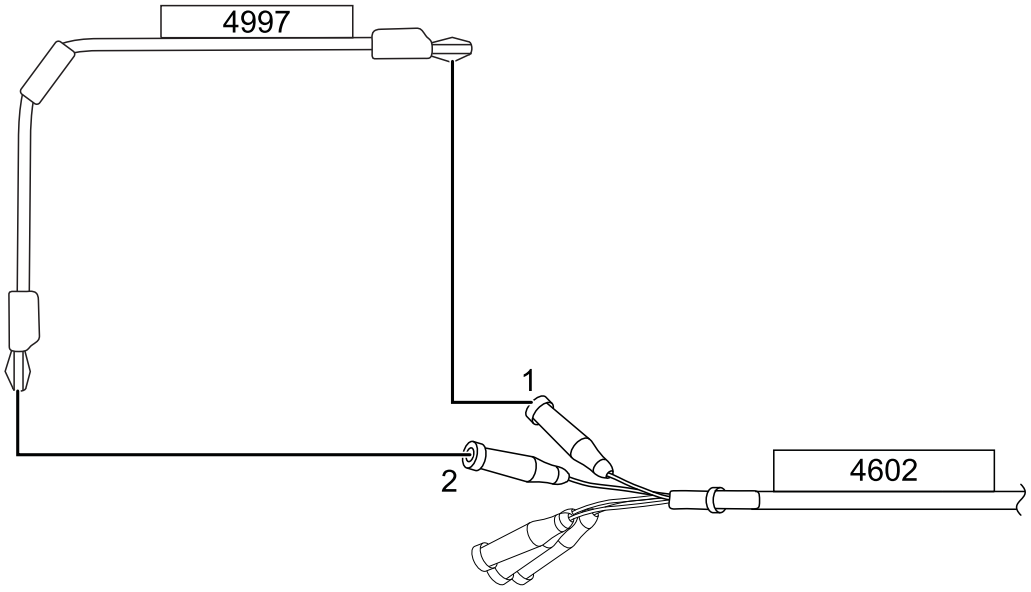


Figure 431 Engine Oil Temperature (EOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334621

Figure 432 Test 1 EOT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Go to Test 3.
	No: Go to Test 2.

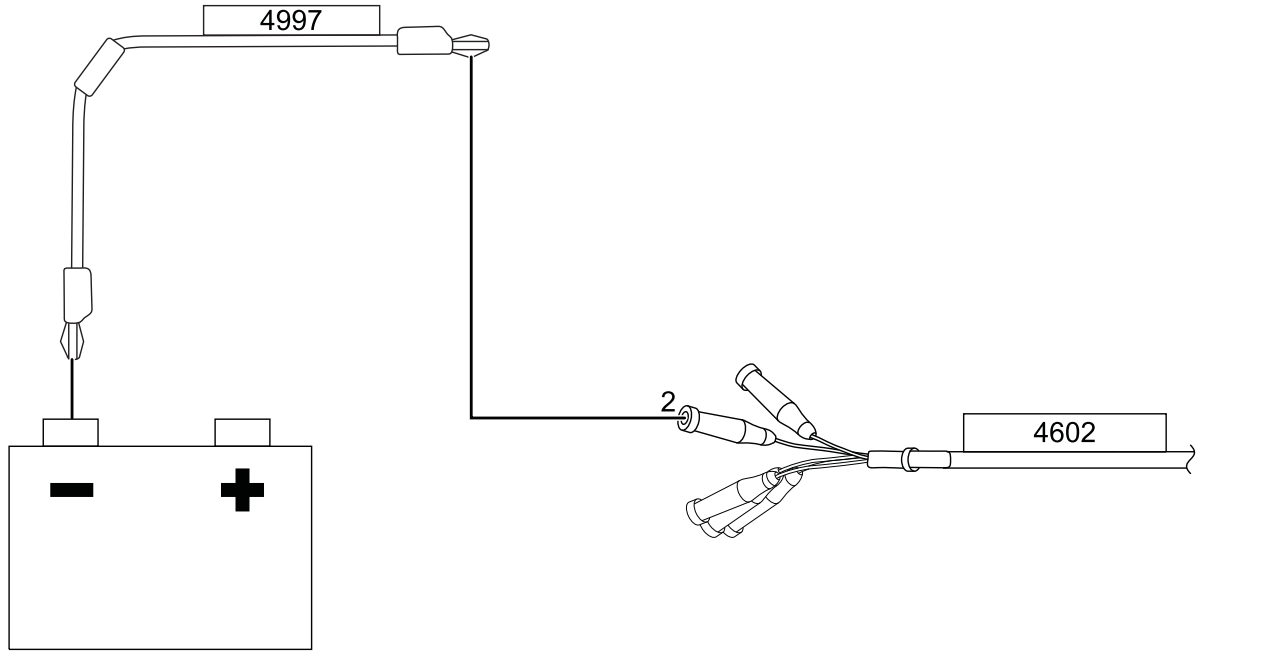
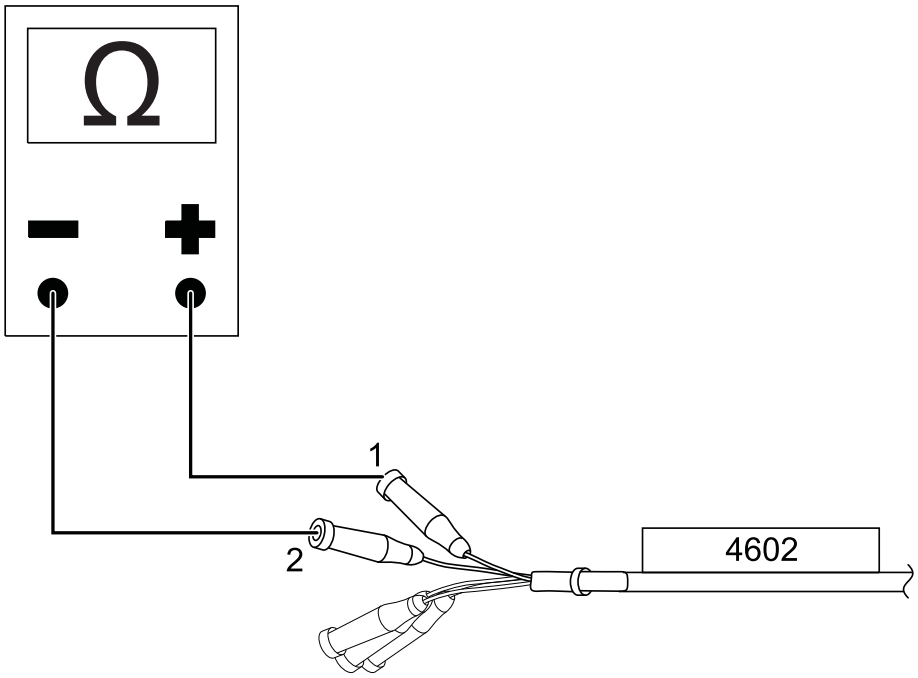


Figure 433 Test 2 EOT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Repair high resistance in SIG GND circuit between EOT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 175 FMI 7.
	No: Repair high resistance in EOT circuit between EOT pin-2 and ECM pin E-66. After repairs are complete, retest for SPN 175 FMI 7.



0000339781

Figure 434 Test 3 EOT Signal Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and pin-2.	See Engine Specifications for EOT sensor(page 2405).
Decision	
Is resistance within specification?	Yes: Replace oil system module thermal valve assembly. After repairs are complete, retest for SPN 175 FMI 7.
	No: Replace EOT sensor. After repairs are complete, retest for SPN 175 FMI 7.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 175 FMI 7 fault code diagnostics.

ETP (Engine Throttle Valve Position)

Overview of ETP Sensor Group

SPN	FMI	Description
51	3	ETP signal Out of Range HIGH (page 1189)
51	4	ETP signal Out of Range LOW (page 1192)
51	7	ETP does not agree with commanded position (page 1198)
3464	31	Intake Throttle Valve short circuit fault (page 1202)

Overview

Engine Throttle Valve Position (ETP) is used to control air/fuel mixture during a regeneration process of Aftertreatment (AFT) system. ETP is also used to insure smooth engine shutdown by restricting airflow to engine at shutdown.

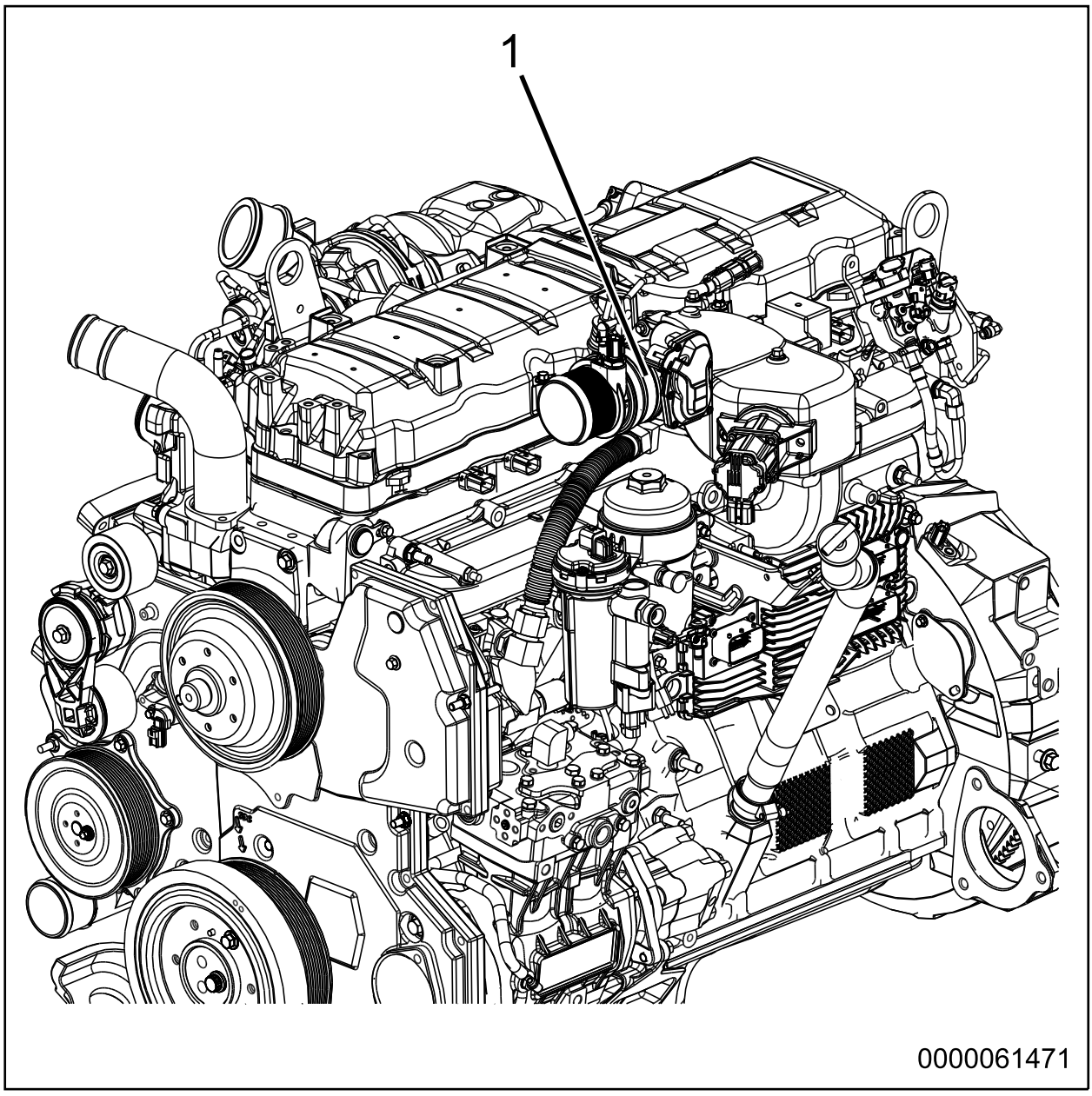


Figure 435 ETP Sensor Location

1. Engine Throttle Valve Position (ETP)

SPN 51 FMI 3 - ETP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Engine Throttle Valve Position (ETP) sensor Out of Range High	Actuator Feedback Signal > 4.902 Volts	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Engine Throttle Valve Position (ETP) signal is greater than 4.902 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ETP circuit short to PWR
- Failed ETP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1189). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 51 FMI 3.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 51 FMI 3 Does EST DTC list show SPN 51 FMI 3 as active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Engine Throttle Valve Position (ETP) sensor.	Decision
A. Key OFF. B. Disconnect ETP connector. C. Check ETP connector and terminals for damaged or pinched wires; corroded terminals; or loose, bent, or broken connector housing. Are ETP connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 51 FMI 3.

Step 4	Inspect connections at Engine Throttle Valve Position (ETP) sensor.	Decision
A. Key OFF. B. Disconnect Engine Throttle Valve Position (ETP) connector and leave ETP disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. E. Log in to ServiceMaxx™. F. Using EST with ServiceMaxx™, clear DTC list. Does SPN 51 FMI 3 set after DTC list is cleared?		Yes: Repair short to PWR between ETP pin-5 and Engine Control Module (ECM) pin-68. After repairs are completed, retest for SPN 51 FMI 3. No: Replace ETP. After repairs are completed, retest for SPN 51 FMI 3.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 51 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 51 FMI 4 - ETP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Engine Throttle Valve Position (ETP) sensor out of Range Low.	Actuator Feedback Signal < 0.352 Volts	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that Engine Throttle Valve Position (ETP) circuit reading is less than 0.352 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ETP Signal short to GND
- VREF 1 circuit Open
- ETP signal Open
- Failed ETP sensor

Step 1	Check for associated faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1192). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults . After repairs are complete, retest for SPN 51 FMI 4.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 51 FMI 4. Does EST DTC show SPN 51 FMI 4 as active?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Engine Throttle Valve Position (ETP) connector.	Decision
A. Key OFF. B. Disconnect ETP connector. C. Check ETP and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ETP connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 51 FMI 4.

Pin-Point Tests (SPN 51 FMI 4)

ETV Circuit

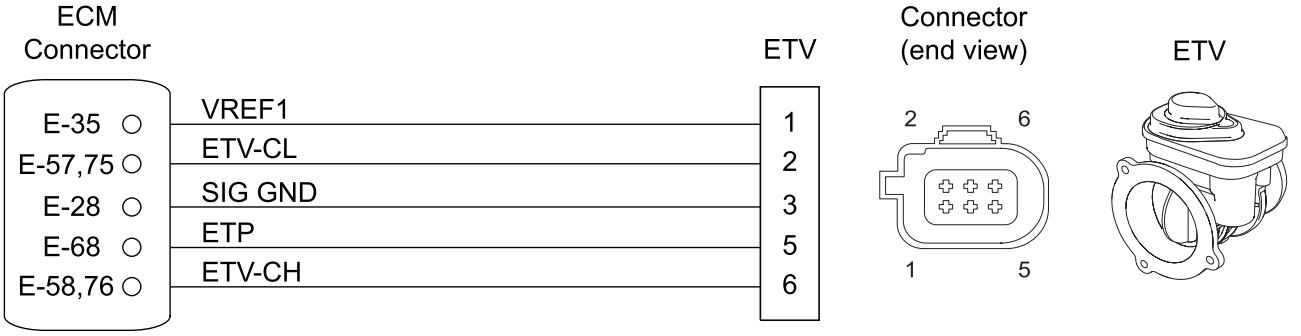


Figure 436 Engine Throttle Valve Position (ETP) circuit diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4735A
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP-1210B-compliant supporting J1939 and J1708)

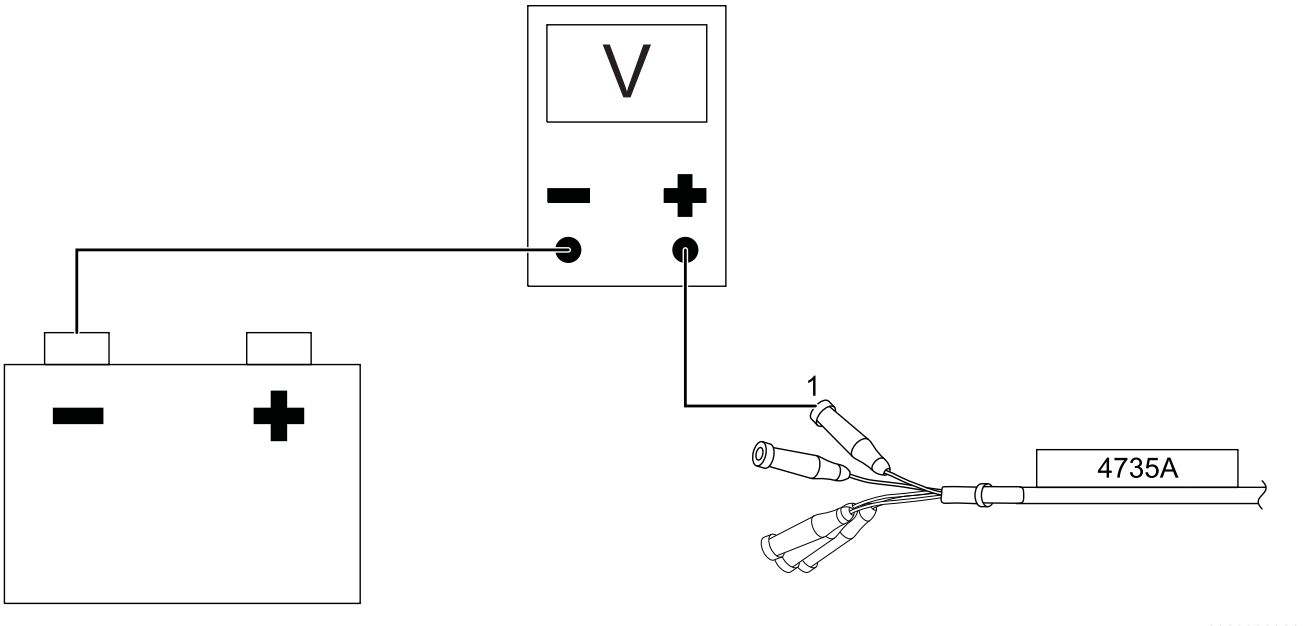


Figure 437 Test 1 VREF1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4735A to Engine Throttle Valve Position (ETP) vehicle harness connector and leave ETP disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4735A pin-1 and known good ground.	Voltage is 5 ± 1 volts
Decision	
Is voltage 5 ± 1 volts?	Yes: Go to Test 2.
	No: Repair Open between ETP pin-1 and Engine Control Module (ECM) pin E-35. After repairs are complete, retest for SPN 51 FMI 4.

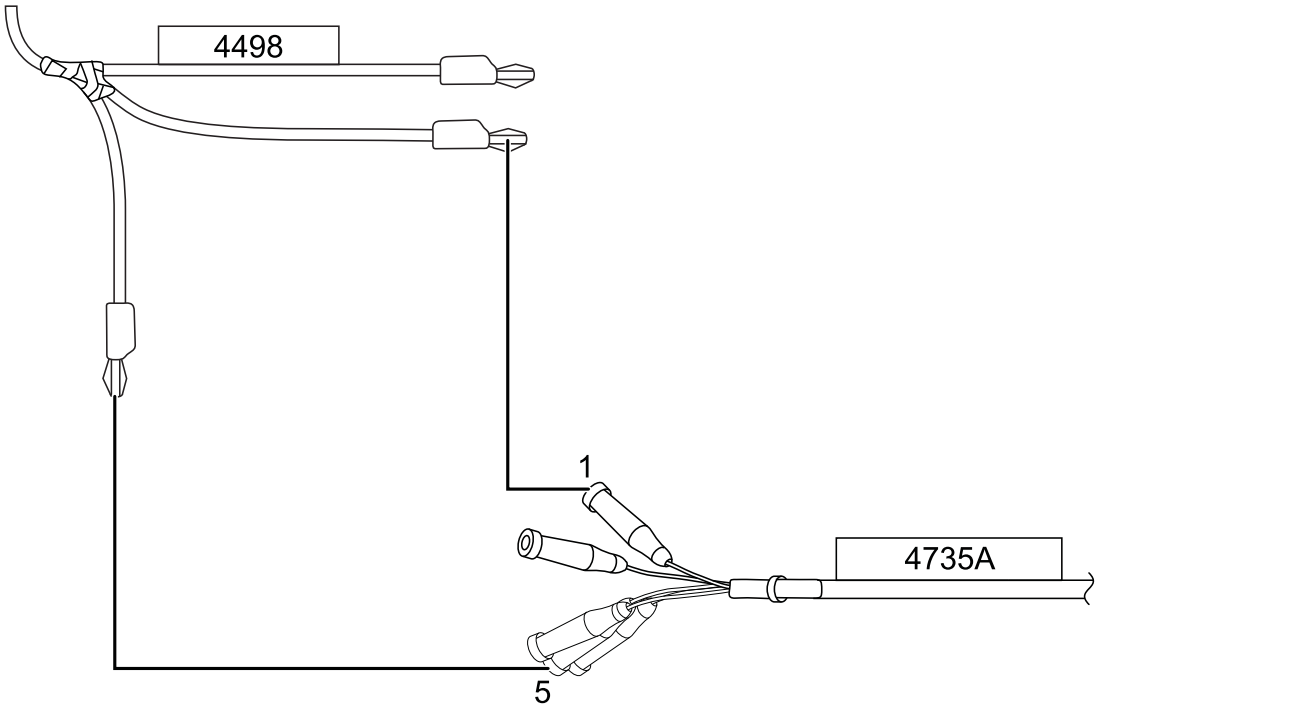
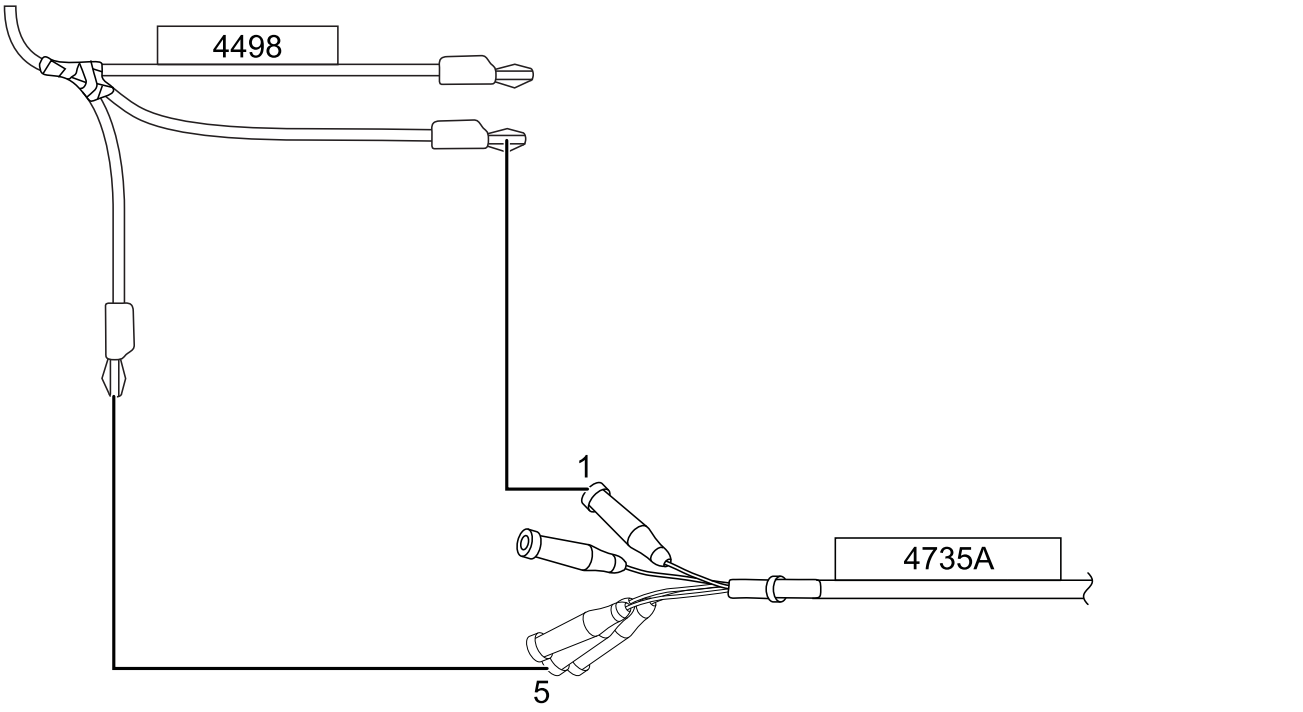


Figure 438 Test 2 Engine Throttle Valve Position (ETP) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4735A to Engine Throttle Valve Position (ETP) vehicle harness connector and leave ETP disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-5 of Breakout Harness ZTSE4735A together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 51 FMI 3 sets in DTC list.
Decision	
Does SPN 51 FMI 3 set after DTC is cleared?	Yes: Replace ETP. After repairs are complete, retest for SPN 51 FMI 4.
	No: Go to Test 3.



0000309309

Figure 439 Pin-Point Test 3 Engine Throttle Valve Position (ETP) Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4735A to Engine Throttle Valve Position (ETP) vehicle harness connector and leave ETP disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-5 of Breakout Harness ZTSE4735A together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3509 FMI 4 sets in DTC list.
Decision	
Does SPN 3509 FMI 4 set after DTC is cleared?	Yes: Repair short to GND between ETP pin-5 and ECM pin E-43. After repairs are complete, retest for SPN 51 FMI 4.
	No: Repair Open between ETP pin-5 and ECM pin E-43. After repairs are complete, retest for SPN 51 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 51 FMI 4 fault code diagnostics.

SPN 51 FMI 7 - ETP does not agree with commanded position

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Throttle Position Sensor Fault (Positive error) OR Intake Throttle Position Sensor Fault (Negative error)	[Engine Throttle Position sensor Error {Actual MINUS Set point} > 10 % [Engine Throttle Position sensor Error {Actual MINUS Set point} < -15 %	Key ON Time after Engine Start > 10 seconds Engine Intake Throttle is in Closed Loop Control SPN/FMI 51/3 and 51/4 are Not active

Fault Overview

Engine Control Module (ECM) senses a positive or negative error in Engine Throttle Position (ETP) sensor based on actual throttle position minus throttle position set point after 25 seconds. ETP must be in closed loop control.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Vehicles that chronically experience this fault condition in cold weather may require use of winter fronts to help with issue. Note that an open SRTN does NOT set a circuit fault (Type 2 error) and does set a mechanically sticking fault (Type 1 error). The voltage is approximately constant 4 volts with an open SRTN.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open Signal Return
- Sticking ETP valve
- Broken gears
- Frozen gears (water ingestion that turned to ice)

Step 1	Check for active fault codes	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 51 FMI 7. Is EST DTC list free of SPN 51 FMI 7?		Yes: Go to Step 2.
		No: Repair SPN 51 FMI 7 faults. After repairs are complete, retest for SPN 51 FMI 7.

Step 2	Inspect Engine Throttle Valve Position (ETP).	Decision
Inspect ETP valve for signs moisture, condensation, or freezing. Is ETP valve dry and not frozen.		Yes: Perform Pin-Point Tests.
		No: Warm and dry ETP. Use winter front in cold weather to eliminate fault. After repairs are complete, retest for SPN 51 FMI 7.

Pin-Point Tests (SPN 51 FMI 7)

ETV Circuit

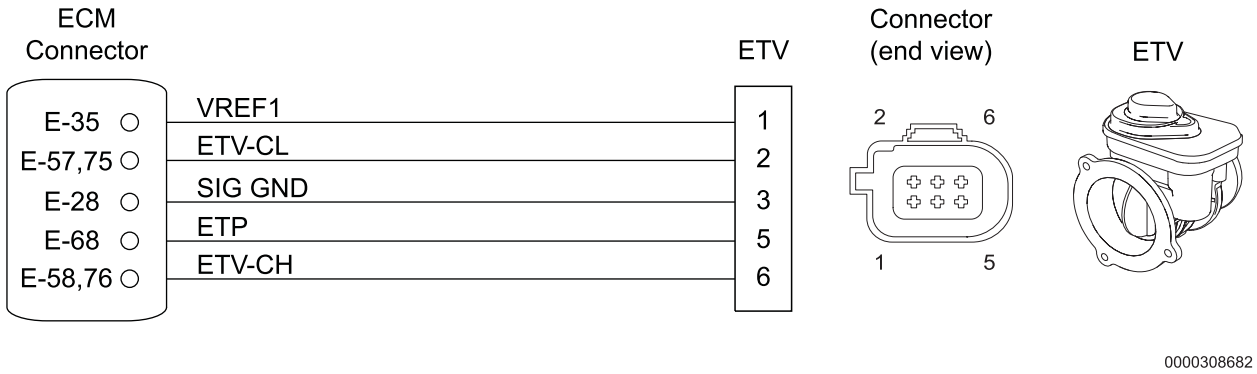


Figure 440 Engine Throttle Valve Position (ETP) Circuit Diagram

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B compliant supporting J1939 and J1708)
- Digital Multimeter (DMM)
- Breakout Harness ZTSE4735A

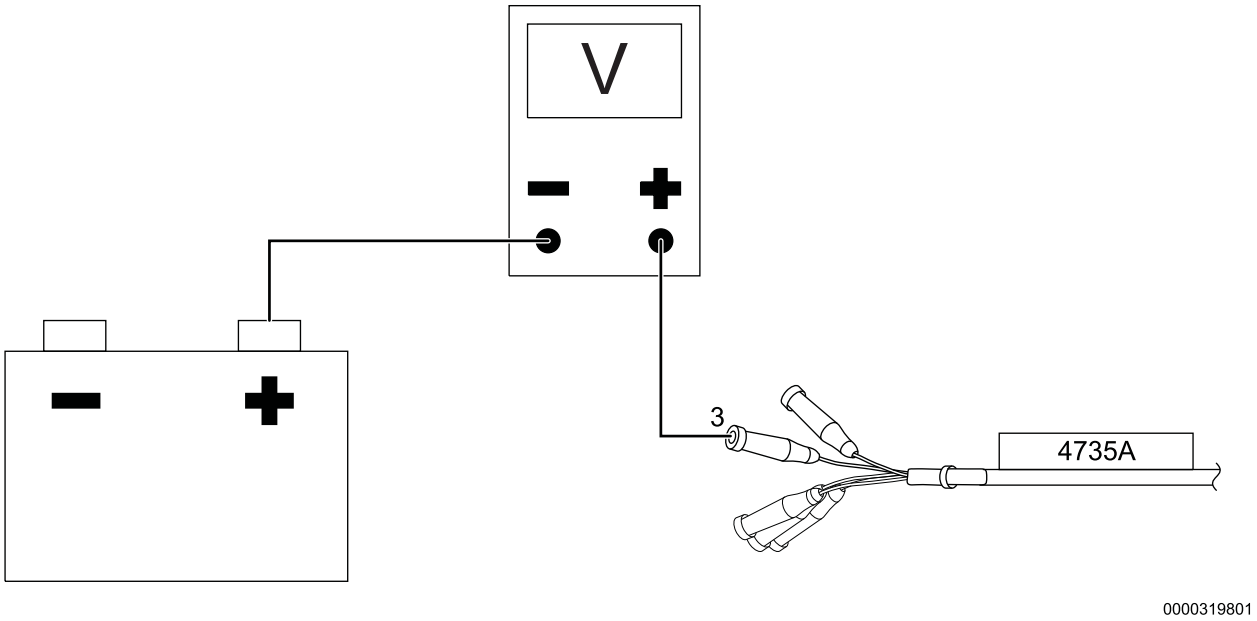


Figure 441 Test 1 Engine Throttle Valve Position (ETP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4735A to vehicle connector and leave Engine Throttle Valve Position (ETP) disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4735 pin-3 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace ETP. After repairs are complete, retest for SPN 51 FMI 7.
	No: Repair Open / High resistance. After repairs are complete, retest for SPN 51 FMI 7.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 51 FMI 7 fault code diagnostics.

SPN 3464 FMI 31 - Intake Throttle Valve short circuit fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Throttle Actuator Control Short circuit	Current through ETV H or ETV L Driver > 8 Amps for 0.010 seconds	Key ON SPN/FMI's 3509/3, 3509/4, 3510/3, 3510/4, 3511/3, and 3511/4 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) detects Short circuit on Intake Throttle Actuator Control

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ETV-CL Short to GND
- ETV-CH Short to GND
- ETV-CL Short to PWR
- ETV-CH Short to PWR
- Failed Engine Throttle Control (ETC)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3464 FMI 31. Is EST DTC list SPN 3464 FMI 31 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Engine Throttle Control (ETC) connector.	Decision
A. Key OFF. B. Disconnect ETC. C. Check ETC and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are ETC connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3464 FMI 31.

Pin-Point Tests (SPN 3464 FMI 31)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4735A
- Digital Multimeter (DMM)

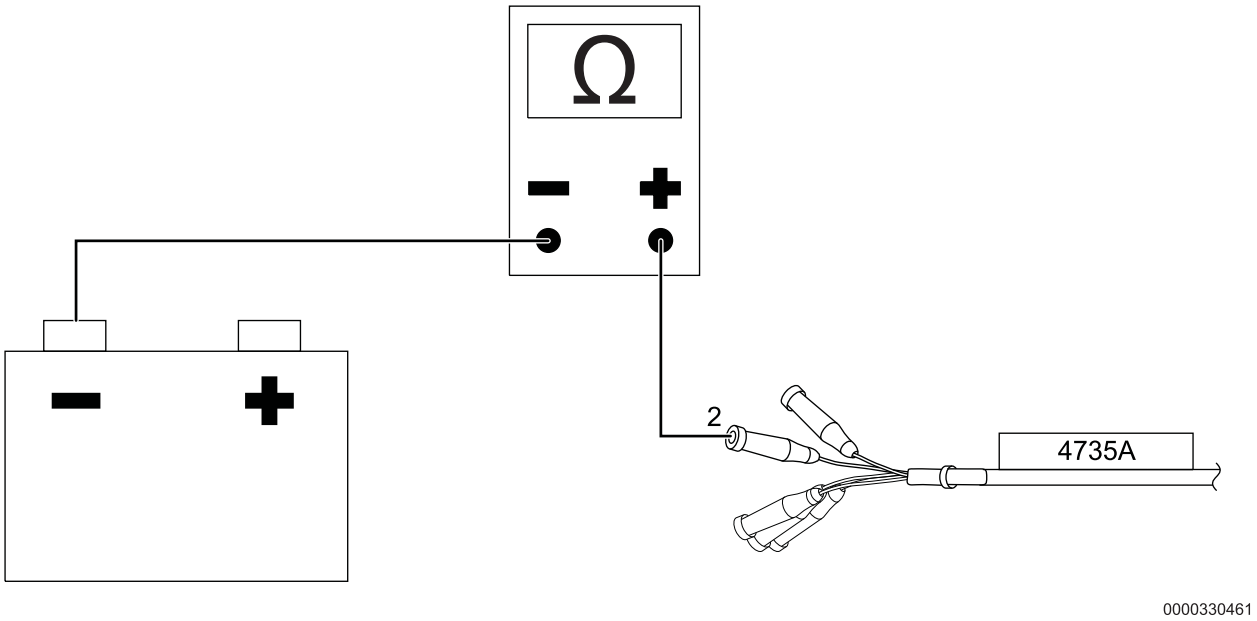


Figure 442 Test 1 Engine Throttle Control (ETC) connector Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Engine Throttle Control (ETC) connector. C. Connect Breakout Harness ZTSE4735A to vehicle harness and leave ETC connector disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4735A pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short to GND between ETV pin-2 and ECM pin-57, pin-75. After repairs are complete, retest for SPN 3464 FMI 31.

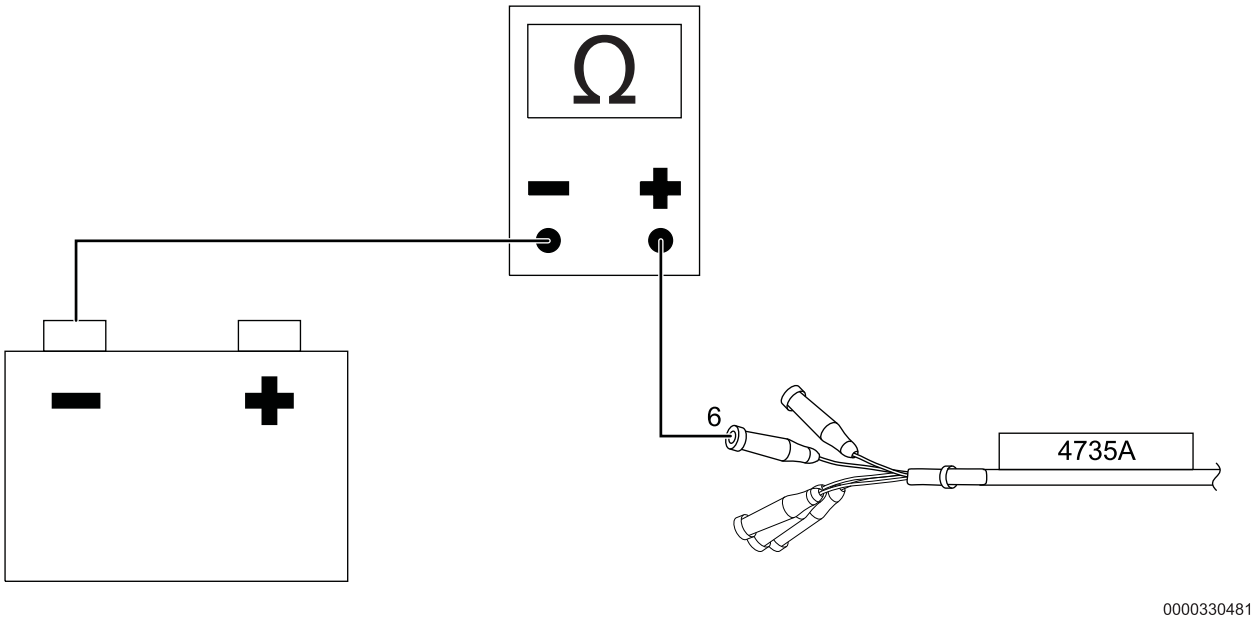


Figure 443 Test 2 Engine Throttle Control (ETC) connector Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Throttle Control (ETC) connector. C. Connect Breakout Harness ZTSE4735A to vehicle harness and leave ETC connector disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4735A pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Repair short to GND between ETV pin-6 and ECM pin-58 and pin-76. After repairs are complete, retest for SPN 3464 FMI 31

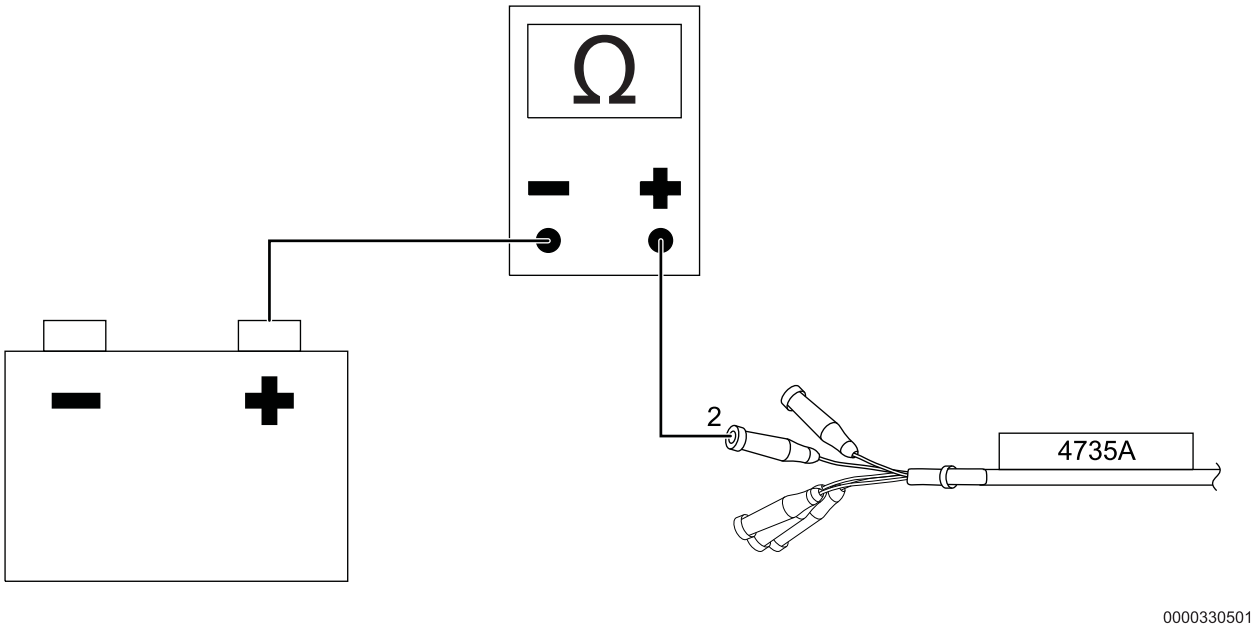


Figure 444 Test 3 Engine Throttle Control (ETC) connector Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Engine Throttle Control (ETC) connector. C. Connect Breakout Harness ZTSE4735A to vehicle harness and leave ETC connector disconnected. D. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4735A pin-2 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 4.
	No: Repair short to PWR between ETV pin-2 and ECM pin-57 and pin-75. After repairs are complete, retest for SPN 3464 FMI 31.

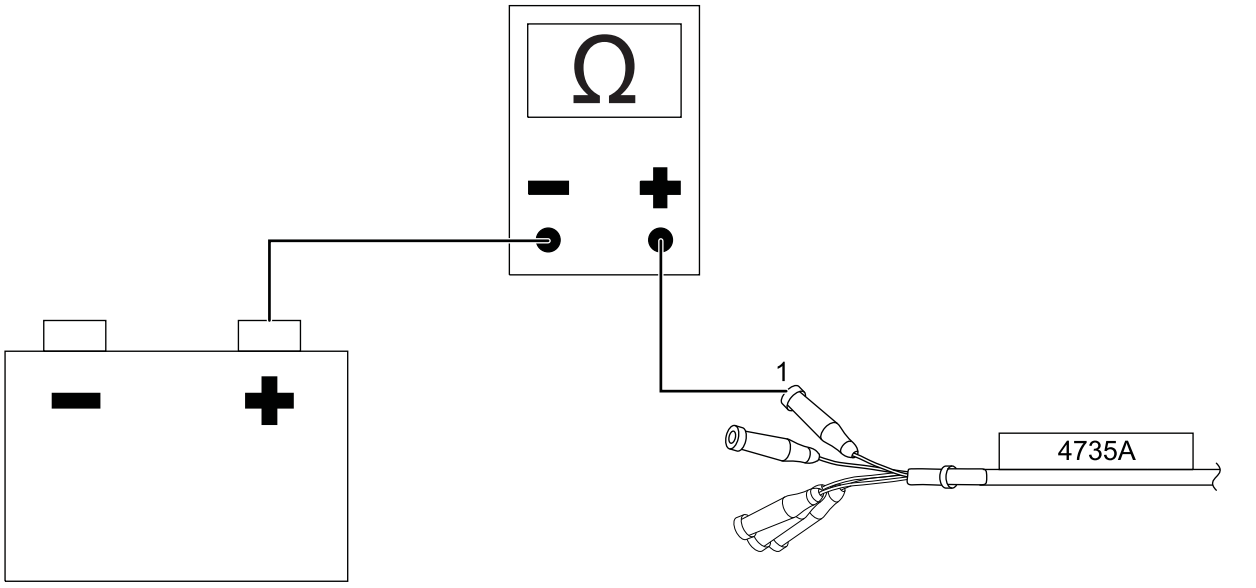


Figure 445 Test 4 Engine Throttle Control (ETC) connector Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Engine Throttle Control (ETC) connector. C. Connect Breakout Harness ZTSE4735A to vehicle harness and leave ETC connector disconnected. D. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4735A pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Replace ETV. After repairs are complete, retest for SPN 3464 FMI 31.
	No: Repair short to PWR between ETV pin-6 and ECM pin-58 and pin-76. After repairs are complete, retest for SPN 3464 FMI 31.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3464 FMI 31 fault code diagnostics.

EWPS (Engine Warning Protection System)

Overview of EWPS Sensor Group

SPN	FMI	Description
100	1	Engine Oil System below Critical Pressure (page 1213)
100	18	Engine Oil System below Warning Pressure (page 1215)
110	0	Engine Cooling System above Critical Temperature (page 1217)
110	15	Engine Cooling System above Warning Temperature (page 1219)
110	16	ECT1 stuck in range High (page 1221)
111	1	ECL below Warning/Critical Level (page 1224)
111	2	ECL signal erratic, intermittent, or incorrect (page 1228)
175	15	Engine Oil System above Warning Temperature (page 1230)
190	0	Engine Overspeed - Most Severe Level (page 1236)
593	31	Engine stopped by IST (page 1239)
1378	31	Change Engine Oil Service Interval (page 1242)
3936	0	DPF Soot Load - Severe De-Rate (page 1243)

Overview

Engine Warning Protection System (EWPS), warns operator of conditions that can damage engine.

Standard Warning System is base system in which all engines are equipped. If one of these faults are detected, Engine Control Module (ECM) illuminates red engine lamp and sets corresponding Diagnostic Trouble Codes (DTC).

Following optional features to this base system provide added warning or protection.

Standard Warning

- No engine shutdown available.

- ECT - Engine overheat warning
- EOP - Low engine oil pressure warning

3-way Warning

- No engine shutdown available.

- ECT - Engine overheat warning
- EOP - Low engine oil pressure warning
- ECL - Low engine coolant level warning

3-way Protection

- Engine shutdown is available if critical condition is detected.

- ECT, EOP, ECL - Same as 3-way Warning
- ECT - Engine overheat critical protection

- EOP - Low engine oil pressure critical protection
- ECL - Low engine coolant level critical protection

Warning (Amber Triangle Light):

Temperature above specific threshold sounds a buzzer, illuminates the red OIL / WATER (OWL) lamp, and sets DTC.

Critical (Exclamation Mark Stop Lamp):

Temperature above specific threshold shuts down engine and sets DTC.

Event log (if equipped):

This feature logs occurrences of event according to engine hours and odometer readings.

EWPS Programmable Parameters

- 1 = 3-way Warning
- 2 = 3-way Protection
- 3 = Standard Warning

ECT Warning Temperature:

Specifies temperature threshold where Triangle Warning light and warning buzzer are turned on.

ECT Critical Temperature:

Specifies temperature threshold where an engine shutdown is commanded (Exclamation Engine Stop lamp).

EOP Engine Speed Region Boundary 1 (600 RPM):

Specifies at what RPM a specified oil pressure (EOP Critical Pressure for Region 1) should be detected.

EOP Engine Speed Region Boundary 2 (800 RPM):

Specifies at what RPM a specified oil pressure (EOP Critical Pressure for Region 2) should be detected.

EOP Engine Speed Region Boundary 3 (1000 RPM):

Specifies at what RPM a specified oil pressure (EOP Critical Pressure for Region 3) should be detected.

EOP Warning Pressure for Region 1 (10 psi / 69 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 1. Failure to meet set point turns on the OIL / WATER lamp and warning buzzer.

EOP Warning pressure for Region 2 (16 psi / 110 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 1 but less than EOP Engine Speed Region Boundary 2. Failure to meet set point turns on the OIL / WATER lamp and warning buzzer.

EOP Warning Pressure for Region 3 (20 psi / 138 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 2, but less than EOP Engine Speed Region Boundary 3. Failure to meet set point turns on the OIL / WATER lamp and warning buzzer.

EOP Critical Pressure for Region 1 (7.5 psi / 52 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 1. Failure to meet set point commands an engine shut down.

EOP Critical Pressure for Region 2 (12 psi / 83 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 1, but less than EOP Engine Speed Region Boundary 2. Failure to meet set point commands an engine shutdown.

EOP Critical Pressure for Region 3. (15 psi / 103 kPa):

Specifies the minimum oil pressure with engine speed greater than EOP Engine Speed Region Boundary 2 but less than EOP Engine Speed Region Boundary 3. Failure to meet set point commands an engine shutdown.

SPN 100 FMI 1 - Engine Oil System below Critical Pressure

Condition / Description	Setting Criteria	Pressure Conditions / Condition Values
Engine Oil System below Critical Pressure		

Fault Overview

Fault sets when Engine Control Module (ECM) senses Engine Oil Pressure (EOP) is below Critical Pressure.

Associated Faults

SPN 100 FMI 3 and 4 (EOP)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low oil level
- High oil level
- Failed EOP sensor
- Oil pressure regulator stuck open
- Broken, missing, or loose piston cooling jets
- Missing, damaged, or worn bearing / camshaft bushings
- Failed oil pump
- Oil aeration
- Loose rocker arm bolt or worn rocker shaft

Step 1	Troubleshoot Low Oil Pressure issues.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1213). Is EST DTC list free of Associated Faults?		Yes: Perform Diagnostic Troubleshooting Procedures: 7.6 - Low Oil Pressure. After repairs are complete, retest for SPN 100 FMI 1.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 100 FMI 1.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 100 FMI 1 fault code diagnostics.

SPN 100 FMI 18 - Engine Oil System below Warning Pressure

Condition / Description	Setting Criteria	Pressure Conditions / Condition Values
Engine Oil System below Warning Pressure		

Fault Overview

Fault sets when Engine Control Module (ECM) senses Engine Oil Pressure (EOP) is below Warning Pressure.

Associated Faults

• SPN 100 FMI 1 (EWPS)	• SPN 100 FMI 3 and 4 (EOP)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low oil level
- High oil level
- Failed EOP sensor
- Oil pressure regulator stuck open
- Broken, missing, or loose piston cooling jets
- Missing, damaged, or worn bearing inserts / camshaft bushings
- Failed oil pump
- Oil aeration
- Loose rocker arm bolt or worn rocker shaft

Step 1	Troubleshoot Low Oil Pressure issues.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1215). Is EST DTC list free of Associated Faults?		Yes: Perform Diagnostic Troubleshooting Procedures: 7.6 - Low Oil Pressure. After repairs are complete, retest for SPN 100 FMI 18.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 100 FMI 18.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 100 FMI 18 fault code diagnostics.

SPN 110 FMI 0 - Engine Cooling System above Critical Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant System above Critical Temperature		

Fault Overview

Fault is set by Engine Control Module (ECM) when Engine Coolant Temperature 1 (ECT1) is above 240°F (116°C). When temperature drops below 240°F (116°C), fault will become inactive.

For high altitude application, 15 psi (103 kPa) radiator cap, fault is set by ECM when ECT1 is above 246°F (119°C). When temperature drops below 246°F (119°C), fault will become inactive.

Lamp Reaction

Engine shutdown is commanded and Red Stop Lamp (RSL) active.

Associated Faults

None

Fault Facts

This fault sets when Engine Warning Protection System Detects Engine Coolant Temperature has risen above a Critical set point. Fault may be caused by actual high coolant temperature or by a fault in engine coolant temperature sensor circuits.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Incorrect value in Programmable Parameter (PP) 77022.
- Blockage between radiator and Charge Air Cooler (CAC).
- Cooling system overheating
- Degraded coolant

Step 1	Troubleshoot Coolant Over-Temperature issues.	Decision
Use Diagnostic Troubleshooting Procedures: 6.3 – Coolant Over-Temp (page 91).		

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 110 FMI 0 fault code diagnostics.

SPN 110 FMI 15 - Engine Cooling System above Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine coolant at Engine Coolant Temperature 1 (ECT1) is above Warning temperature.	ECT1 > value programmed into Programmable Parameter (PP) 77011	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects that engine coolant temperature at Engine Coolant Temperature 1 (ECT1) is above Programmable Parameter (PP) 77011.

Lamp Reaction

Red Stop Lamp and Warning buzzer turned ON.

Associated Faults

SPN 110 FMI 2, 3, 4 (ECT1)			

Fault Facts

Fault may be set by incorrect value in Programmable parameters in ServiceMaxx™ software.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Incorrect value in Programmable Parameter (PP) 77011
- Engine Overheating

Step 1		Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1219). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest SPN 110 FMI 15.

Step 2	Troubleshoot Engine Coolant Temperature 1 (ECT1) issues.	Decision
Check Programmable Parameter (PP) 77011. Using EST with ServiceMaxx™ software, go to Sessions > Programming > Engine Warn Protection System. Check value, verify with customer desired temperature limit and compare to normal operating temperature. Is PP 77011 programmed correctly?		Yes: Perform Diagnostic Troubleshooting Procedures: 6.3 – Coolant Over-Temp (page 91). No: Program PP 77011 to correct value. After repairs are complete, retest for SPN 110 FMI 15.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 110 FMI 15 fault code diagnostics.

SPN 110 FMI 16 - ECT1 stuck in range High

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant Temperature (ECT1) stuck in range high monitor.	{Engine coolant temperature ≥ 219°F (104°C) AND time spent in high-speed torque zone as defined in [Table A103]} ≤ 400 seconds	Key ON Intake air temperature ≥ -40°F (-40°C) Engine coolant temperature at Startup {Calibrated Out} ≤ 460°F (238°C) [Engine Off soak time ≥ 7200 seconds OR Time spent in high-speed torque zone as defined by (Table A103) from previous driving cycle] ≤ 400 seconds Engine run mode active timer > 120 seconds Exhaust brake position control ≤ 99.97% Ambient pressure {calibrated out} > 1.068 psi (7.363 kPa) Accumulated power {Calibrated Out} > -100 joules/second NOT [{1. Mass of Fuel ≤ 28 mg/stk AND 2. Engine Speed} ≤ 740 RPM Condition 1 and 2 listed above true for at least] ≥ 300 seconds Intake air heater OFF Cold ambient protection mode not active NOT in active regeneration Power Take-off (PTO) mode NOT active [{Percentage time spent below ≤ 740 RPM within a drive cycle} < 0.35 * 100% OR Cumulative time spent below ≤ 740 RPM within a drive cycle] < 300 seconds Not active: SPN/FMIs 132/3, 132/4, 132/0, 132/1, 172/3, 172/4, 172/2, 1173/2, 2630/2, 108/3, 108/4, 4765/3, 4765/4, 110/3, 110/4, 110/2, 175/3, 1754, 175/2, 164/0, 164/3, 164/4, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5395/0, 5395/1, 1173/16, 651/14, 652/14, 653/14, 654/14, 655/14, 656/14, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31, 110/18, 4257/0, 4257/1, 164/16, 164/18, and 110/17

Fault Overview

Fault sets when ECT1 signal is stuck in range high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

This fault sets when Engine Warning Protection System (EWPS) detects Engine Coolant Temperature 1 (ECT1) has risen above a critical set point. Fault may be caused by actual high coolant temperature or by a fault in ECT1 sensor circuit.

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Low coolant level
- Check for leaks or boiling out

Step 1	Troubleshoot Engine Coolant Temperature 1 (ECT1) issues.	Decision
Use Diagnostic Troubleshooting Procedures: 6.3 – Coolant Over-Temp (page 91).		

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 110 FMI 16 fault code diagnostics.

SPN 111 FMI 1 - ECL Below Warning / Critical Level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Coolant Level (ECL) has fallen below minimum level.	ECL circuit detects low coolant level.	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Engine Coolant Level (ECL) sensor signal detects that coolant level is below minimum level

Lamp Reaction

Red Stop Lamp will illuminate when this fault is detected.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Low coolant level
- Engine cooling system mechanical failure
- Failed ECL sensor or circuit

Step 1	Check coolant level.	Decision
Perform Coolant Level Inspection . Is Coolant level low, is there evidence of coolant loss, or does operator complain of coolant leaks or consumption?		Yes: Go to Step 2. No: Perform Coolant Loss Symptom Diagnostics (page 89).

Step 2	Inspect connections at Engine Coolant Temperature 1 (ECT1) sensor.	Decision
A. Key OFF. B. Disconnect ECT1 sensor connector. C. Check ECT1 sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the ECT1 sensor, connector, harness, and terminals clean and undamaged?		Yes: Go to step 3 No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 111 FMI 1.

Step 3	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 111 FMI 1. A. Key ON, clear codes. B. Key OFF, wait for EST screen to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 111 FMI 1. Is EST DTC list SPN 111 FMI 1 active or pending?		Yes: Go to step 4. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 4	Check if SPN 111 FMI 1 is still active.	Decision
Perform Test 1 (page 1227). Using Electronic Service Tool (EST) with ServiceMaxx™ software: A. Key ON, clear codes. B. Key OFF, wait for EST screen to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 111 FMI 1.		Yes: Repair short between ECL and Engine Control Module (ECM) pin C2-49. After repairs are complete, retest for SPN 111 FMI 1.

Is EST DTC list SPN 111 FMI 1 still active?	
	No: Replace ECL sensor. After repairs are complete, retest for SPN 111 FMI 1.

Pin-Point Tests (SPN 111 FMI 31)

Figure 446 ECL Sensor Circuit Diagram

See latest version of Navistar® N13 Engine and Aftertreatment Wiring Schematic Form 0000009301 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Engine Coolant Level (ECL) sensor.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 111 FMI 1 fault code diagnostics.

SPN 111 FMI 2 - ECL signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

SPN 175 FMI 15 - Engine Oil System above Warning Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Oil Temperature (EOT) above Warning Temperature	EOT > value programmed into Programmable Parameter (PP) 77012	Key ON

Fault Overview

This fault is set by Engine Control Module (ECM) when Engine Oil Temperature (EOT) is above 261°F (127°C). ECM illuminates red lamp (OWL). When temperature drops below 261°F (127°C) SPN/FMI will become inactive.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

This fault sets when Engine Warning Protection System (EWPS) detects Engine Oil Temperature (EOT) has risen above a desired set point. Fault may be caused by actual high oil temperature or by a fault in EOT sensor circuit.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- High resistance EOT circuit
- High resistance SIG GND circuit
- Failed EOT sensor
- Failed oil system module thermal valve assembly

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 175 FMI 15. Is EST DTC list SPN 175 FMI 15 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Engine Oil Temperature (EOT) connector.	Decision
A. Key OFF. B. Disconnect EOT connector. C. Check EOT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are EOT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 175 FMI 15.

Pin-Point Tests (SPN 175 FMI 15)

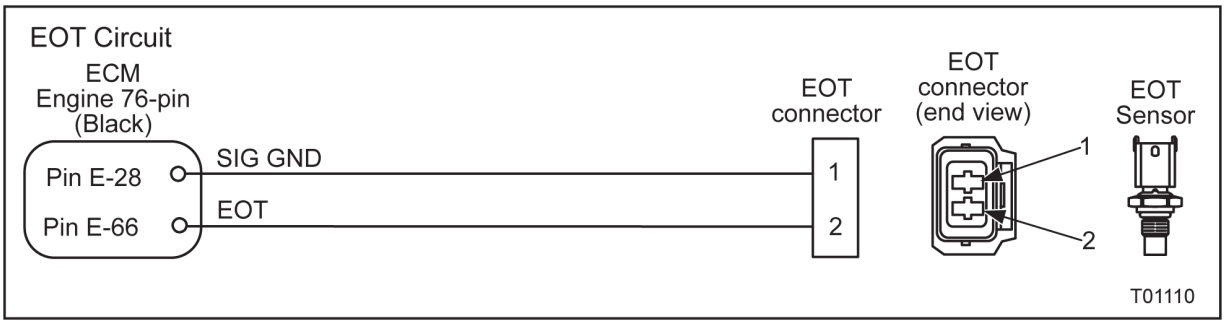
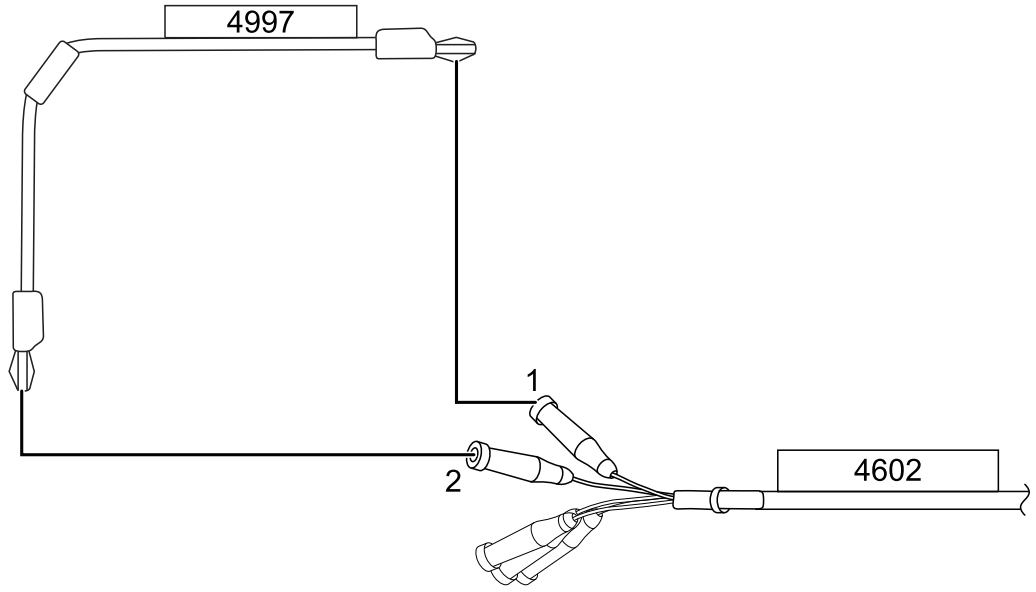


Figure 448 Engine Oil Temperature (EOT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4602
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334621

Figure 449 Test 1 EOT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Go to Test 3.
	No: Go to Test 2.

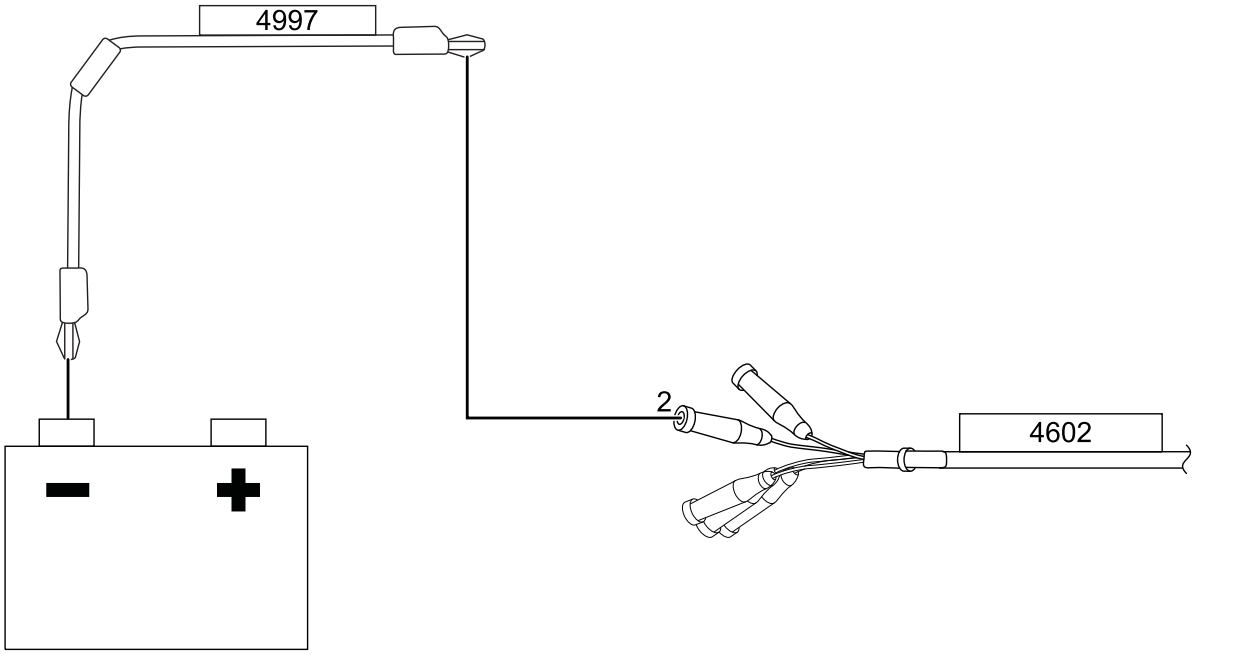
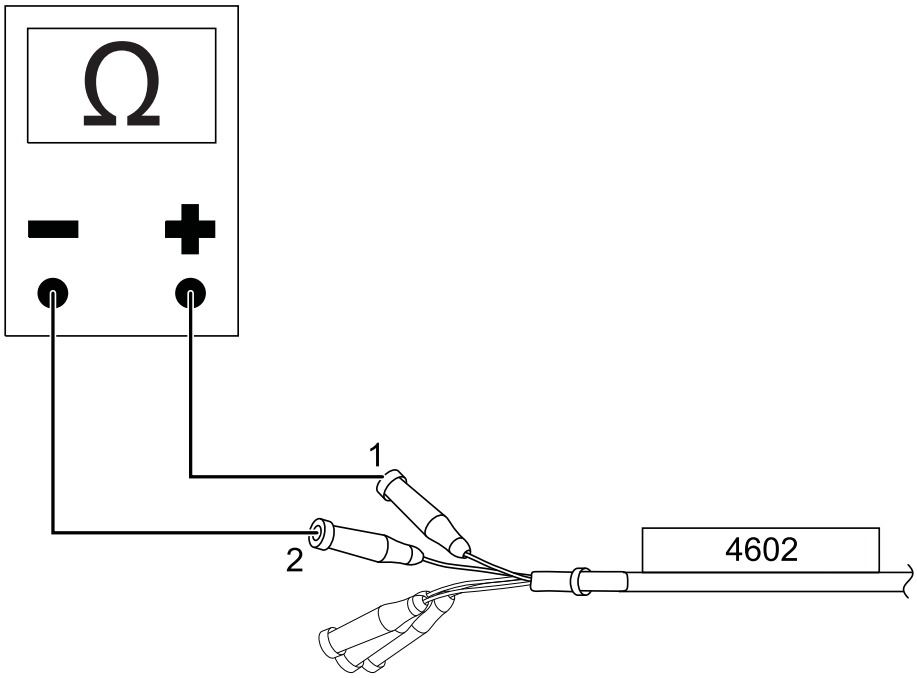


Figure 450 Test 2 EOT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4602 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor engine oil temperature.	194 ± 10°F (90 ± -12.2°C)
Decision	
Is temperature 194 ± 10°F (90 ± -12.2°C)?	Yes: Repair high resistance in SIG GND circuit between EOT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 175 FMI 15.
	No: Repair high resistance in EOT circuit between EOT pin-2 and ECM pin E-66. After repairs are complete, retest for SPN 175 FMI 15.



0000339781

Figure 451 Test 3 EOT Signal Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect Engine Oil Temperature (EOT) sensor. C. Connect Breakout Harness ZTSE4602 to vehicle harness connector and leave EOT sensor disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4602 pin-1 and pin-2.	See Engine Specifications for EOT sensor(page 2405).
Decision	
Is resistance within specification?	Yes: Replace oil system module thermal valve assembly. After repairs are complete, retest for SPN 175 FMI 15.
	No: Replace EOT sensor. After repairs are complete, retest for SPN 175 FMI 15.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 175 FMI 15 fault code diagnostics.

SPN 190 FMI 0 - Engine overspeed - Most Severe Level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine speed reaches most severe level with Accelerator Pedal Position (APP) and Vehicle Speed Sensor (VSS) at 0% or 0.	Engine speed exceeds 2600 rpm with no fuel being requested	Vehicle speed < 0.1 mph APP < 0.1% RAPP < 0.1% Engine speed > 2600 rpm

Fault Overview

Fault sets only when a vehicle is stationary and engine speed reaches 2600 rpm with no fuel being requested by Engine Control Module (ECM). Once conditions are met, ECM will initiate a protection strategy. Engine Throttle Valve (ETV) and Exhaust Gas Recirculation (EGR) valve will be closed and fuel injectors disabled. Fuel Pressure Control Valve (FPCV) will open to relieve fuel rail pressure in case of injector tip damage. A full engine analysis needs to be completed to assess damage from excessive engine speed before engine can be started.

Lamp Reaction

Malfunction Indicator Lamp (MIL) and Red Stop Lamp (RSL) will illuminate when this fault is detected.

Associated Faults

None

Fault Facts

SPN 190 FMI 0 is set by Engine Control Module (ECM) when engine rpm has exceeded 3,200 rpm.

Drive Cycle to Determine Fault Status

Continuous (engine running)

Possible Causes

- Excessive engine speed in an unintended downshift.
- Steep acceleration downhill without correct brake application.
- External fuel source being ingested into intake air system.

Step 1	Visual inspection of turbocharger outlet pipe.	Decision
Remove turbocharger outlet pipe and Charge Air Cooler (CAC) outlet pipe and inspect for oil. Is there excessive oil coming from high-pressure turbocharger?		Yes: Go to Step 2. No: Go to Step 7.

Step 2	Visually inspect engine.	Decision
Visually inspect engine block. Is there external damage to block?		Yes: Replace engine. Warranty policy applies. After repairs are complete, retest for SPN 190 FMI 0. No: Go to Step 3.

Step 3	Check parameter 58071 Maximum Trip RPM.	Decision
Use Electronic Service Tool (EST) with ServiceMaxx™ software to check parameter(Figure 855). Is parameter 58071 above 3,200 rpm?		Yes: Go to Step 4. No: Go to Step 5.

Step 4	Check if engine RPM is greater than 3,200.	Decision
Drop oil pan and inspect for block/liner damage. Is there damage to block or liner?		Yes: Repair or replace engine. Warranty policy applies. After repairs are complete, retest for SPN 190 FMI 0. No: Replace injectors, turbocharger cartridge, water pump, and clean Charge Air Cooler (CAC). Go to Step 6.

Step 5	Check if engine RPM is less than 3,200 rpm but greater than 2,600 rpm.	Decision
Drop oil pan and inspect for block/liner damage. Is there damage to block or liner?		Yes: Repair or replace engine. Warranty policy applies. After repairs are complete, retest for SPN 190 FMI 0. No: Replace injectors, turbocharger cartridge, water pump, and clean Charge Air Cooler (CAC). Go to Step 6.

Step 6	Check calibration.	Decision
Use EST with ServiceMaxx™ software to check calibration. Is calibration up to date?		Yes: Clear trip report and release truck to service. After repairs are complete, retest for SPN 190 FMI 0.
		No: Update calibration and release truck to service. After repairs are complete, retest for SPN 190 FMI 0.

Step 7	Visually inspect engine.	Decision
Visually inspect engine block. Is there damage to engine block?		Yes: Replace engine. Warranty policy applies. After repairs are complete, retest for SPN 190 FMI 0.
		No: Go to Step 8.

Step 8	Check parameter 58071 Maximum Trip RPM.	Decision
Use EST with ServiceMaxx™ software to check parameter(Figure 855). Is parameter 58071 above 3,200 rpm?		Yes: Go to Step 9.
		No: Clear trip report and release truck to service. After repairs are complete, retest for SPN 190 FMI 0.

Step 9	Check if engine RPM is greater than 3,200.	Decision
Drop oil pan and inspect for block/liner damage. Is there damage to block or liner?		Yes: Repair or replace engine. Warranty policy applies. After repairs are complete, retest for SPN 190 FMI 0.
		No: Replace water pump. Go to Step 6.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 190 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 593 FMI 31 - Engine Stopped by IST

Function

Idle Shutdown Timer (IST) allows Engine Control Module (ECM) to shut down engine during extended engine idle times.

Tools

- Digital Multimeter (DMM) (page 2428)
- Interface cable (RP1210B compliant supporting J1939 and J1708)



GOVERNMENT REGULATION: State and local regulations may limit engine idle time. Vehicle owner or operator is responsible for compliance with those regulations.

Idle Shutdown Warning

Thirty seconds before IST-defined engine shutdown, a vehicle instrument panel indicator activates. There are two types of indicators:

- Amber flashing idle shutdown indicator for multiplex electrical systems
- Red flashing indicator with audible alarm for non-multiplex electrical systems

This continues until the engine shuts down or the low idle shutdown timer is reset.

Engine Idle Shutdown Timer (IST) for California ESS Compliant Engines

Navistar® engines certified for sale in state of California (CA) conform to mandatory California Air Resources Board (CARB) Engine Shutdown System (ESS) regulations. Prior function of IST is available on CA ESS-exempt and federally-certified engines (school buses, emergency, and military vehicles).

Engine idle duration is limited for ESS-compliant engines as follows:

- When vehicle parking brake is set, idle shutdown time is limited to CARB requirement of 5 minutes.
- When vehicle parking brake is released, idle shutdown time is limited to CARB requirement of 15 minutes.

Duration of CARB-mandated values can be reduced by programming customer IST programmable parameter to value lower than 15 minutes. Adjusting this parameter reduces overall system shutdown time as follows:

- Adjusting parameter value between 5 and 15 minutes reduces idle shutdown time with vehicle parking brake released. Default value of 5 minutes for vehicle parking brake set condition remains unaffected.
- Adjusting parameter value between 2 and 5 minutes reduces idle time for both vehicle parking brake released and set conditions.

While IST is installed, idle shutdown time is factory-defaulted to 60 minutes and cannot be adjusted. If IST is enabled, Cold Ambient Protection (CAP) will not function.

CARB IST feature is factory-programmed. Customers cannot turn IST off for ESS-compliant engines.

CARB Idle Shutdown Timer (IST) Conditions

The following conditions must be true for the idle shutdown timer to activate in all modes. Any change of the true state of one or more of these conditions will reset or disable the IST.

- Manual Diesel Particulate Filter (DPF) regeneration is inactive (not enabled).
- Steady drive-line state (no transition detected). No change in the state of the clutch switch (manual transmission) or transmission shifter between the in-gear position and neutral or park (Automatic transmission).
- Power Takeoff (PTO) remote mode disabled.
- Engine coolant temperature greater than 60°F (16°C).
- No active coolant temperature sensor diagnostic faults.
- No active Intake Air Temperature (IAT) sensor diagnostic faults.
- Engine is operating in run mode or in active diagnostic tool mode.
- Vehicle speed is less than 1.25 mph.
- No active vehicle speed diagnostic faults.
- PTO control is in OFF or Standby mode.
- Engine speed less than 700 rpm.
- Steady accelerator pedal position (no transition detected from any pre-set position).
- Steady brake pedal state (no transition detected from any pre-set state).
- Steady parking brake state (J1939) (no transition detected from any pre-set state).

Idle Shutdown Timer (IST) (Federal – Optional)

Idle time can be programmed from 5 to 120 minutes. While IST is installed, IST function will be active with the programmed shutdown time in effect. Parking brake transitions reset idler timer. If IST is enabled, Cold Ambient Protection (CAP) will not function.

Federal IST Conditions

Following conditions must be true for IST to activate. Any change to true state of one or more of these conditions will reset or disable IST.

Common Enable Conditions for All Federal IST Options

- Manual Diesel Particulate Filter (DPF) regeneration is inactive (not enabled).
- Steady drive-line state (no transition detected). No change in the state of the clutch switch (manual transmission) or transmission shifter between the in-gear position and neutral or park (Automatic transmission).
- Power Takeoff (PTO) remote mode disabled.
- Intake air temperature greater than 60°F (16°C) (MFG Default, Customer adjustable parameter).
- Intake air temperature lower than 112°F (44°C) (MFG Default, Customer adjustable parameter).
- Engine coolant temperature greater than 140°F (60°C).
- No active coolant temperature sensor diagnostic faults.

- No active Intake Air Temperature (IAT) sensor diagnostic faults.
- Engine is operating in run mode or in active diagnostic tool mode.
- Vehicle speed is less than 1.25 mph.
- Steady parking brake state (J1939). No transition detected from any pre-set state.

Additional operation options enable conditions depending on selected Federal IST operation mode:

Federal IST Mode 1: PTO Operation Option Enable Conditions

- Power Takeoff (PTO) control is in Off or Standby mode.
- Engine speed less than 750 rpm.
- Accelerator pedal position is less than 2%.
- No active accelerator pedal diagnostic faults.
- Steady brake pedal state (No transition detected).
- No active brake system diagnostic faults.

Federal IST Mode 2: No Load / Light Load Limit Option Enable Conditions

- Accelerator pedal position is less than 2%.
- No active accelerator pedal diagnostic faults.
- Steady brake pedal state (no transition detected).
- No active brake system diagnostic faults.
- Engine reported fuel usage (load) is less than Engine Control Module (ECM)-specified limit (factory-calibrated, not customer adjustable).

Federal IST Mode 3: Tamper Proof Option Enable Conditions

- Engine reported fuel usage (load) is less than Engine Control Module (ECM)-specified limit (factory-calibrated, not customer adjustable).
- Steady accelerator pedal position (no transition detected from any pre-set position).
- Steady brake pedal state (no transition detected from any pre-set state).

Fault Detection / Management

Idle Shutdown Timer (IST) SPN / FMI does not indicate system fault. SPN 593 FMI 31 will set when engine idle shutdown has shut down engine from Engine Control Module (ECM) command. IST feature must be enabled for SPN 593 FMI 31 to be displayed.

SPN 1378 FMI 31 - Change Engine Oil Service Interval

Condition / Description	Setting Criteria	Enable Conditions / Values
Change engine oil service interval.	Programed Parameter for Engine Oil Service has been reached	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects change engine oil service interval is erratic, intermittent, or incorrect.

Lamp Reaction

None

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Change Engine Oil and reset engine oil change reminder

WARNING: To prevent personal injury or death, wear safety glasses and avoid moving components such as fans, pulleys, and belts when taking an engine oil sample.

CAUTION: To prevent engine damage, do not extend recommended oil change intervals.

Step 1	Decision
Change engine oil and oil filter (see Engine Oil and Filter in Section 5 of *Engine Operation and Maintenance Manual*).	Reset the change engine oil service interval counter.

End Diagnostic Step
After performing diagnostic step, if SPN 1378 FMI 31 remains, verify if step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 3936 FMI 0 - DPF Soot Load – Severe De-Rate

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
DPF Differential Pressure / Outlet Pressure sensor data valid, but above normal operating range (severe de-rate).	DPF Differential Pressure / Outlet Pressure sensor has exceeded the recommended limits.	Key-On Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects soot load of Diesel Particulate Filter (DPF) has exceeded maximum operating limits for an extended period of time. Torque output of engine will be reduced as soot load increases. Active regeneration of aftertreatment system will be disabled.

Lamp Reaction

Red Stop Lamp (RSL) Active.

Associated Faults

• SPN 94 (FDP)	• SPN 102 (IMP)	• SPN 157 (FRP)	• SPN 651-656 (INJ / CYL)
• SPN 3242 FMI 2, 3, and 4 (DPFIT)	• SPN 3246 FMI 2, 3, and 4 (DPFOT)	• SPN 3480 (AFT: FP1)	• SPN 3482 (AFT: FEC)
• SPN 3556 (AFT)	• SPN 4765 FMI 2, 3, and 4 (DOCIT)	• SPN 5541 (TC1TOP)	

Fault Facts

This fault code indicates exhaust temperatures exiting turbocharger are Not high enough. Repeated occurrences of this fault code may indicate engine requires frequent regeneration of aftertreatment system. To passively regenerate aftertreatment system, operate engine under higher load and higher rpm.

Drive Cycle to Determine Fault Status

Continuous (engine running)

Possible Causes

- Engine performance problem
- Failed fuel injector
- Engine mechanical fault
- Regen inhibited
- Restricted DPFDP hoses
- Failed DPFDP sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1243). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3936 FMI 0.

Step 2	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for SPN 94 (FDP), SPN 102 (IMP), SPN 157 (FRP), SPN 651-656 (INJ / CYL), and SPN 5541 (TC1TOP). Is EST DTC list free of SPN 94, SPN 102, SPN 157, SPN 651-656, and SPN 5541?		Yes: Go to Step 3. No: Repair SPN 94, SPN 102, SPN 157, SPN 651-656, and SPN 5541. After repairs are complete, retest for SPN 3936 FMI 0.

Step 3	Determine if a regen inhibitor is inhibiting regeneration of aftertreatment system.	Decision
Using EST with ServiceMaxx™ software, go to KOER Aftertreatment DPF Regeneration Procedure. Does DPF Filter Regeneration procedure run without any active Inhibitors?		Yes: Go to Step 4. No: Correct active regen inhibitors. After repairs are complete, retest for SPN 3936 FMI 0.

Step 4	Inspect connections at DPF Differential Pressure (DPFDP) / outlet pressure sensor.	Decision
A. Key OFF B. Disconnect DPFDP / outlet pressure sensor Check DPFDP / outlet pressure sensor and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are DPFDP / outlet pressure sensor connector, harness, and terminals clean and undamaged?		Yes: Go to Step 5. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3936 FMI 0.

Step 5	Monitor DPFDP / outlet pressure sensor signal.	Decision
Key ON Engine OFF (KOEO). Using EST with ServiceMaxx™ software, load Signals session and monitor DPFDP. Is DPFDP below 0.5 psi? (normal operation)		Yes: Go to Step 7. No: Go to Step 6.

Step 6	Check DPFDP sensor hoses for correct routing and restrictions.	Decision
Inspect the DPFDP sensor hoses for kinks, improper hose routing, restrictions, or damage. Are DPFDP sensor hoses routed correctly, free of damage, and unrestricted?		Yes: Replace DPF Differential Pressure / Outlet Pressure sensor. After repairs are complete, retest for SPN 3936 FMI 0. No: Repair or replace DPFDP sensor hose(s). After repairs are complete, retest for SPN 3936 FMI 0.

Step 7	Determine if engine has mechanical cylinder balance problem (compression loss).	Decision
Perform Crankcase Pressure Test. Does engine have excessive crankcase pressure?		Yes: Repair base engine compression imbalance. After repairs are complete, retest for SPN 3936 FMI 0. No: Go to Step 8.

Step 8	Determine if engine has a fuel injector problem.	Decision
Perform Multiple Cylinder Cutout Test(page 2184). Did one or more cylinders have significant speed difference(s) than the others?		Yes: Go to Step 9. No: Go to Step 10.

Step 9	Inspect for failed valve train components.	Decision
Remove upper valve cover (see Engine Service Manual). Inspect for bent valves, fallen bridges, and valves out of adjustment. Is valve train free of failed valve train components?		Yes: Replace injector suspected by Multiple Cylinder Cutout Test. After repairs are complete, retest for SPN 3936 FMI 0. No: Repair failed valve train components. After repairs are complete

	retest for SPN 3936 FMI 0.

Step 10	Determine if vehicle has an engine performance related driveability problem.	Decision
Test drive the vehicle. Does engine have a performance problem?		Yes: Perform Engine Running, Engine Under Load Symptoms(page 36). After repairs are complete, retest for SPN 3936 FMI 0.
		No: Retest for SPN 3936 FMI 0.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3936 FMI 0 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

FDP (Fuel Delivery Pressure) Sensor

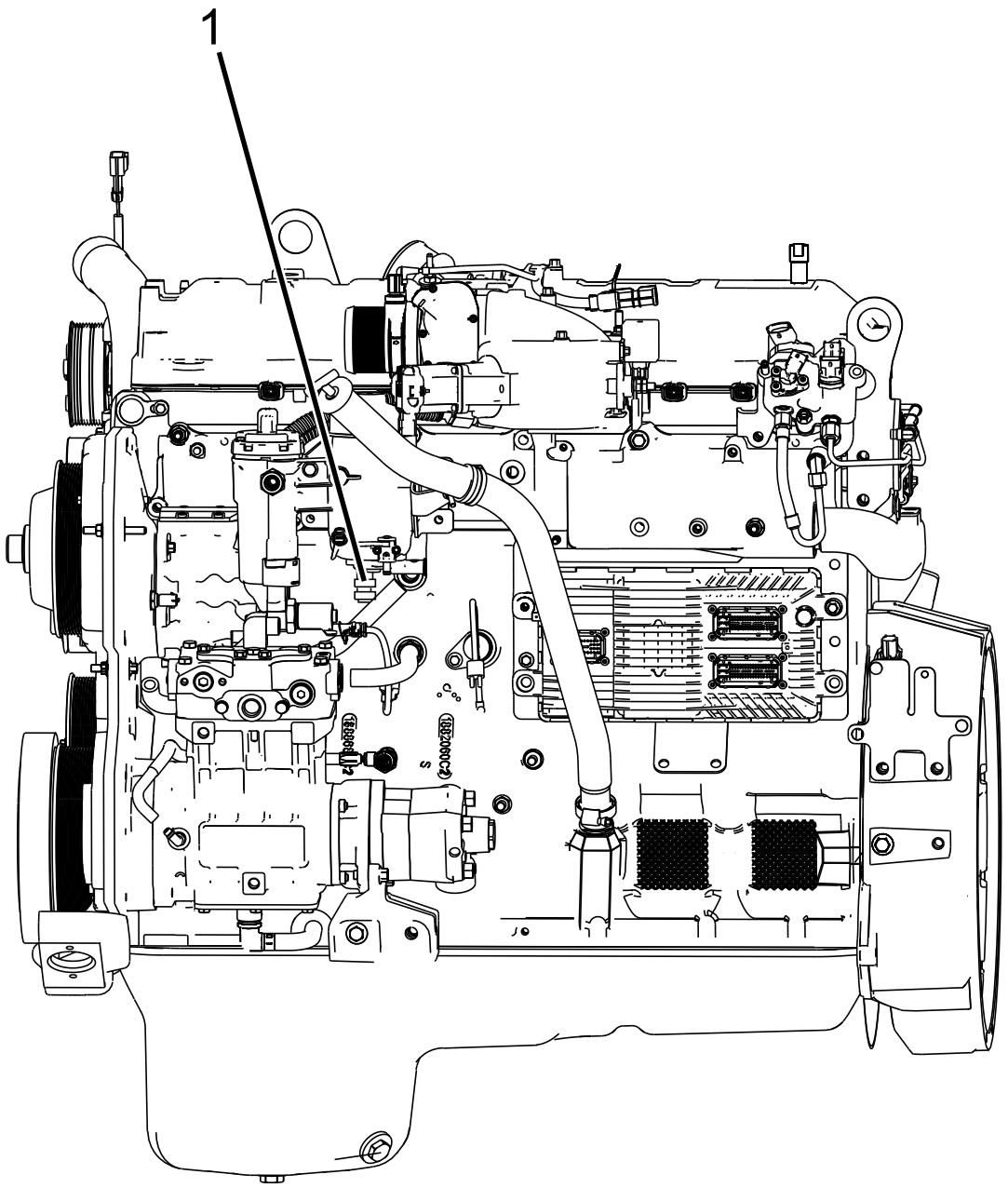
Overview of FDP Sensor Group

SPN	FMI	Description
94	3	FDP signal Out of Range HIGH (page 1249)
94	4	FDP signal Out of Range LOW (page 1254)
94	17	Fuel Delivery Pressure below minimum (page 1261)
94	18	Fuel Delivery Pressure below min during cranking (page 1263)

Overview

Fuel Delivery Pressure (FDP) sensor provides feedback signal to Engine Control Module (ECM) indicating engine fuel pressure. During engine operation, if pressure is not satisfactory, ECM will turn on amber FUEL lamp to alert operator when fuel filter needs servicing.

FDP sensor is only capable of measuring up to 75 psi (517 kPa) of pressure, even though fuel pressure normally operates at 90 psi (621 kPa).



0000061518

Figure 452 FDP Sensor Location

1. Fuel Delivery Pressure (FDP) sensor

SPN 94 FMI 3 - FDP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel Delivery Pressure (FDP) sensor voltage is greater than expected.	FDP sensor voltage > 4.912 Volts (152 psi {1049 kPa}) AND Pre-debounce time ≥ 10 seconds	Key ON Inactive: SPN 3509 FMI 3 and 4 (VREF1)

Fault Overview

Fault sets when Fuel Delivery Pressure (FDP) sensor signal voltage is greater than 4.912 volts (152 psi {1049 kPa}) for 5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- FDP circuit short to PWR
- SIG GND circuit Open
- Failed FDP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1249). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 3.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 94 FMI 3. Is EST DTC list show SPN 94 FMI 3 as Active or Pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete, retest for SPN 94 FMI 3.

Step 3	Inspect connections at Fuel Delivery Pressure (FDP) sensor.	Decision
A. Key OFF. B. Disconnect FDP sensor connector. C. Check FDP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are FDP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 94 FMI 3.

Pin-Point Tests (SPN 94 FMI 3)

FDP Circuit

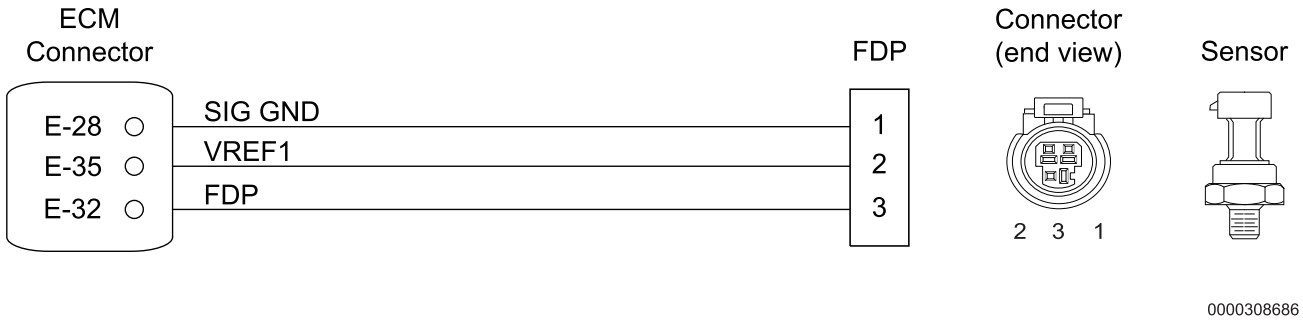


Figure 453 Fuel Delivery Pressure (FDP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Fuel Delivery Pressure (FDP) sensor vehicle harness connector. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector . D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 94 FMI 3 sets in DTC list.
Decision	
Does SPN 94 FMI 3 set after DTC list is cleared?	Yes: Repair short to PWR between FDP pin-3 and Engine Control Module (ECM) pin E-32. After repairs are complete, retest for SPN 94 FMI 3.
	No: Go to Test 2.

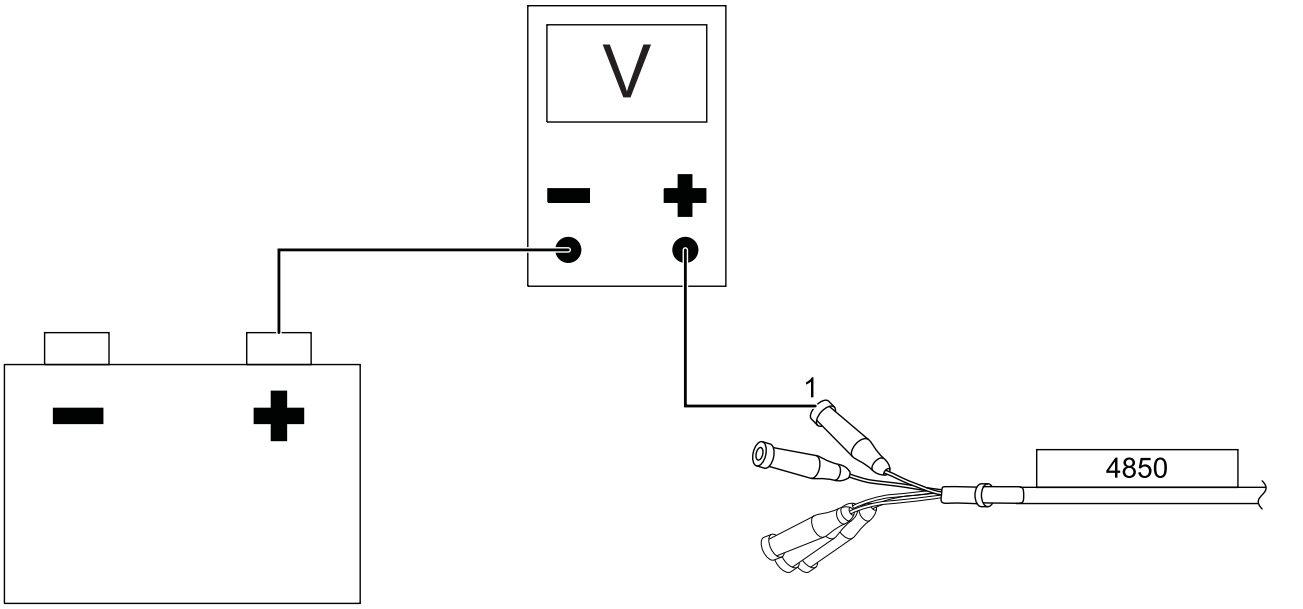


Figure 454 Test 2 SIG GND Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Fuel Delivery Pressure (FDP). C. Connect Breakout Harness ZTSE4850 to vehicle harness connector and leave FDP disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-1 and PWR	12 ± 0.5 volts
Decision	
Is voltage 12 ± 0.5 volts?	Yes: Replace FDP sensor. After repairs are complete, retest for SPN 94 FMI 3.
	No: Repair Open between FDP pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 94 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 94 FMI 3 fault code diagnostics.

SPN 94 FMI 4 - FDP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Engine Fuel Delivery Pressure (FDP) Sensor Out of Range Low.	Engine Fuel Delivery Pressure Sensor Voltage < 0.093 Volts AND Pre-debounce time ≥ 10 seconds	Key ON Inactive: SPN 3509 FMI 3 and 4 (VREF 1)

Fault Overview

Fault sets when Fuel Delivery Pressure (FDP) sensor signal voltage is less than 0.093 volts for 5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- FDP circuit Open
- FDP circuit short to GND
- VREF1 circuit Open
- Failed FDP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1254). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 4.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 4. Does EST DTC list show SPN 94 FMI 4 as Active or Pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123). After repairs are complete retest, for SPN 94 FMI 4.

Step 3	Inspect connections at Fuel Delivery Pressure (FDP) sensor.	Decision
A. Key OFF. B. Disconnect FDP sensor connector. C. Check FDP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are FDP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 94 FMI 4.

Pin-Point Tests (SPN 94 FMI 4)

FDP Circuit

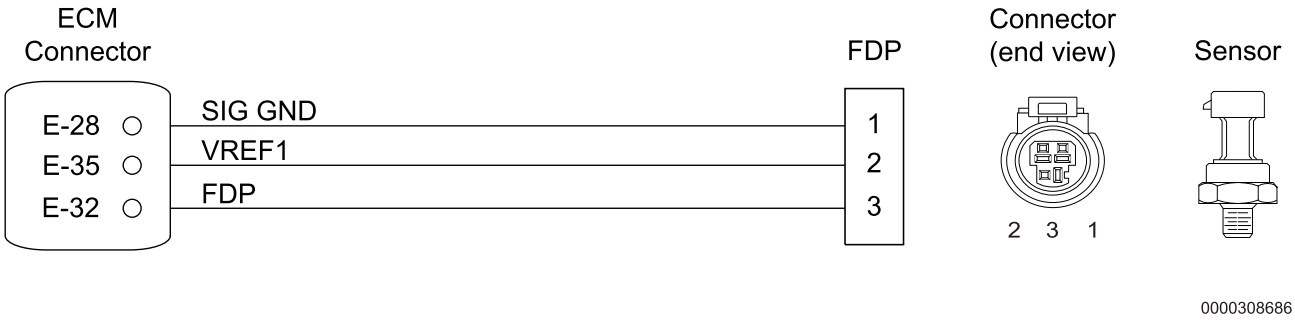


Figure 455 Fuel Delivery Pressure (FDP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

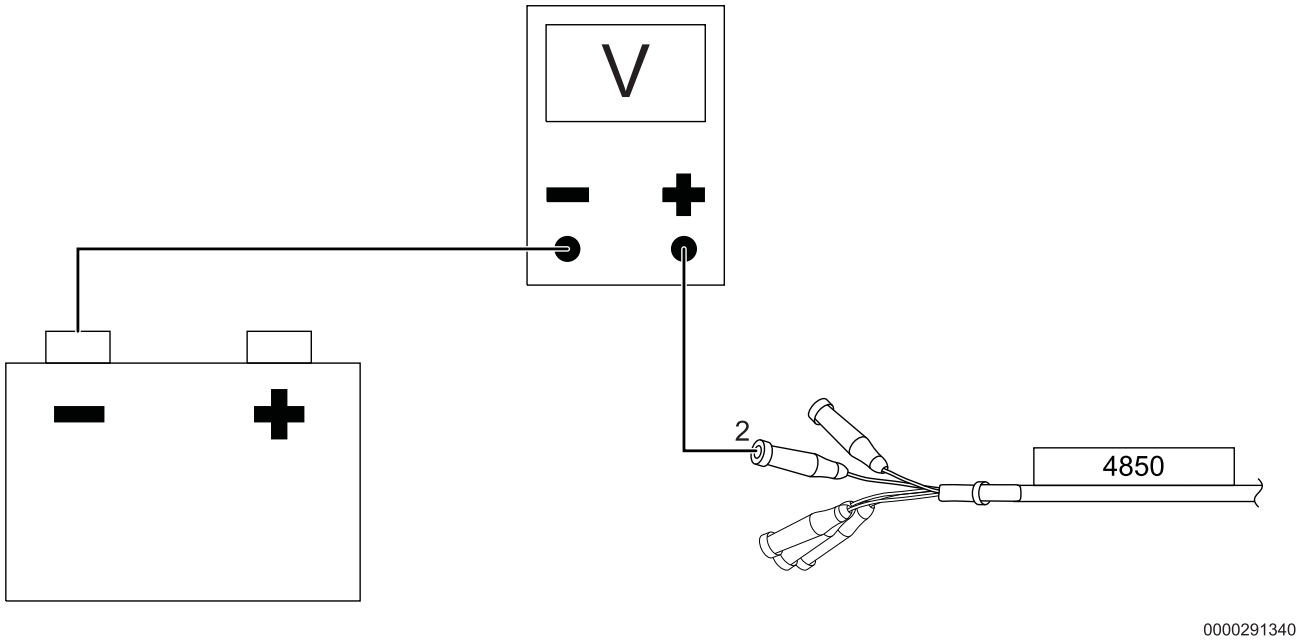
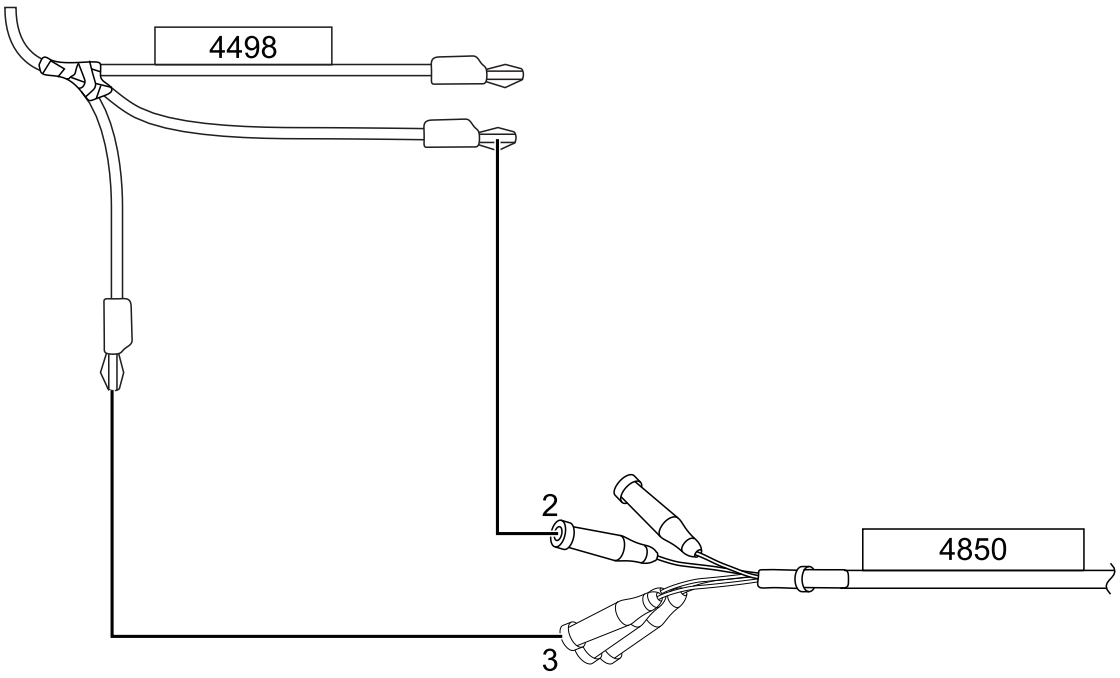


Figure 456 Test 1 VREF1 Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Fuel Delivery Pressure (FDP) vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and GND.	5 ± 1 volts
Decision	
Is voltage 5 ± 1 volts?	Yes: Go to Test 2.
	No: Repair Open between FDP pin-2 and Engine Control Module (ECM) pin E-35. After repairs are complete, retest for SPN 94 FMI 4

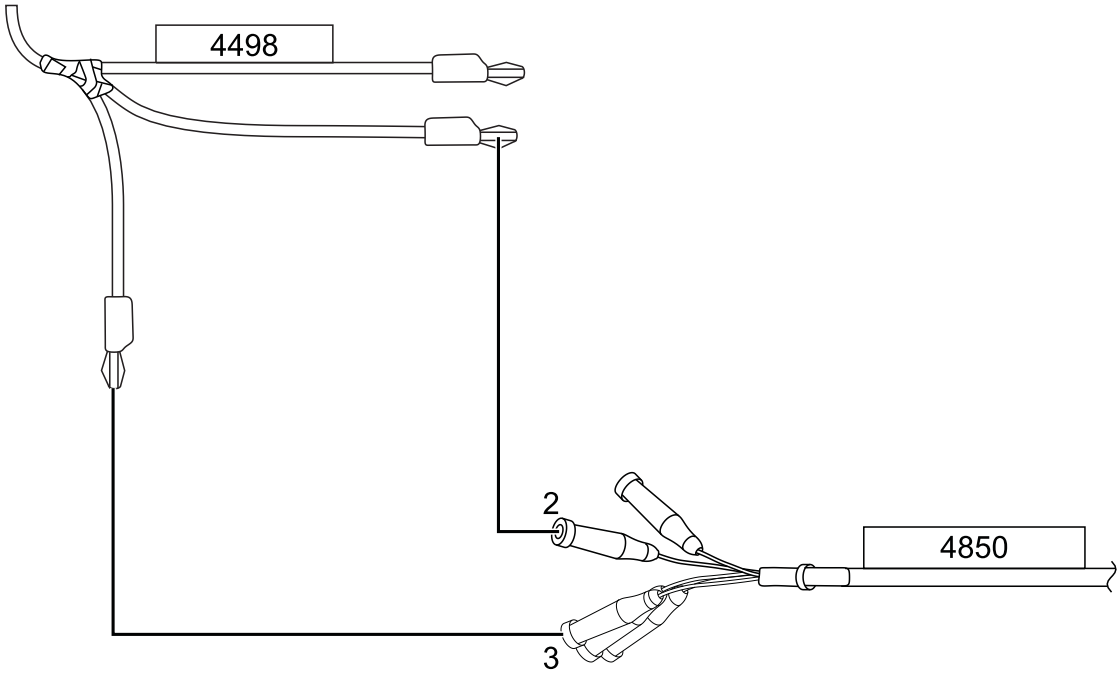


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Figure 457 Test 2 Fuel Delivery Pressure (FDP) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). C. Key ON. Log in to ServiceMaxx™ software. D. Connect Breakout Harness ZTSE4850 to Fuel Delivery Pressure (FDP) vehicle harness connector and leave sensor disconnected. E. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 94 FMI 3 sets in DTC list.
Decision	
Does SPN 94 FMI 3 set after DTC list is cleared?	Yes: Replace FDP sensor. After repairs are complete, retest for SPN 94 FMI 4.
	No: Go to Test 3.



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Figure 458 Test 3 FDP Sensor Circuit Check

Test 3 Setup
A. Key OFF.
B. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
C. Key ON. Log in to ServiceMaxx™ software.
D. Connect Breakout Harness ZTSE4850 to Fuel Delivery Pressure (FDP) vehicle harness connector and leave sensor disconnected.
E. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3509 FMI 4 sets in DTC list.
Decision	
Does SPN 3509 FMI 4 set in DTC list?	Yes: Repair short to ground between FDP pin-3 and ECM pin E-32. After repairs are complete, retest for SPN 94 FMI 4.
	No: Repair Open between FDP pin-3 and ECM pin E-32. After repairs are complete, retest for SPN 94 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 94 FMI 4 fault code diagnostics.

SPN 94 FMI 17 - Fuel Delivery Pressure below minimum

Condition/Description	Setting Criteria	Enable Conditions / Values
Fuel Delivery Pressure (FDP) below minimum	60 psi (414 kPa) in 45 seconds	> 600 rpm in 10 seconds

Fault Overview

None

Lamp Reaction

Wrench lamp will illuminate when this fault is active.

Associated Faults

• SPN 94 FMI 1 (EFP)	• SPN 94 FMI 18 (FDP)	• SPN 931 FMI 4 (EFP)	

Fault Facts

Fault is normally caused by fuel filter needing to be changed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Recent fuel system service requiring priming
- Vehicle unused for long period of time requiring priming
- Low fuel level
- Diesel fuel contamination
- Failed secondary (engine mounted) fuel filter
- Failed primary (chassis mounted) fuel filter
- Restricted strainer
- Restricted / leaking fuel supply
- Failed fuel pressure regulator

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1261). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 17.

Step 1	Check Fault Code Status	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 17 (FDP). Is SPN 94 FMI 17 pending or active?		Yes: Go to Fuel Fuel Delivery Pressure symptom (page 120). No: Repair SPN 94 FMI 17. After repairs are complete, retest SPN 94 FMI 17.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 94 FMI 17 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 94 FMI 18 - Fuel Delivery Pressure below min during cranking

Condition/Description	Setting Criteria	Enable Conditions / Values
Fuel Delivery Pressure (FDP) below minimum during engine cranking.	FDP < 45 psi (kpa) for 8 seconds	Engine cranking

Fault Overview

Fault code sets when Fuel Delivery Pressure (FDP) is below 45 psi for 8 seconds while engine is cranking.

Lamp Reaction

None

Associated Faults

SPN 931 FMI 4 (EFP)			

Fault Facts

This fault may set due to fuel gelling, low fuel level, or recent engine service.

Drive Cycles

Engine Cranking

Possible Causes

- Recent fuel system service that required priming
- Diesel fuel waxing or icing in cold temperatures
- Low fuel level in either fuel tank
- Vehicle unused for long period of time
- Unseated fuel filter that causes fuel to drain back to tank
- High resistance in fuel pump circuits
- High resistance in FP GND circuit
- Stuck Open fuel pressure regulator
- Damaged fuel filter
- Completely plugged strainer
- Failed fuel pump

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1263). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 94 FMI 17.

Step 1	Check Fault Code Status	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 94 FMI 18 (FDP). Is SPN 94 FMI 18 pending or active?		Yes: Go to Fuel Fuel Delivery Pressure symptom (page 120). No: Repair SPN 94 FMI 18. After repairs are complete, retest SPN 94 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 94 FMI 18 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

FLI (Fuel Level Signal)

Overview of FLI Sensor Group

SPN	FMI	Condition
96	3	Fuel Level signal Out of Range HIGH (page 1266)
96	4	Fuel Level signal Out of Range LOW (page 1268)
96	19	Fuel Level not detected on J1939 (page 1270)

Overview

Fuel level is broadcast on J1939 public Controller Area Network (CAN) bus. This signal is sent from Body Controller (BC) which is where fuel level signal is received. If BC is not located on J1939 many other CAN networks may be affected.

SPN 96 FMI 3 - Fuel Level signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel level sensor is shorted to high voltage or open / high resistance in fuel level sensor circuit.	Body Controller detects that the fuel level sensor voltage is too high 1 second.	Key ON

Fault Overview

Fault code sets when Body Controller detects high signal voltage on fuel level sensor circuit for more than one second.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel level sensor signal circuit Open or high resistance
- Fuel level sensor GND circuit Open or high resistance
- Fuel level sensor signal circuit Short to PWR
- Failed fuel level sensor

Step 1	Verify that Body Controller (BC) is communicating.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check that BC is listed in Sniffer section. Is Body Controller listed?		Yes: Diagnose fuel level circuit fault. See appropriate Truck Service Manual. After repairs are complete, retest for SPN 96 FMI 3.
		No: Repair Body Controller fault. After repairs are complete, retest for SPN 96 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 96 FMI 3 fault code diagnostics.

SPN 96 FMI 4 - Fuel Level signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel level sensor is shorted to low (GND).	Resistance between fuel level sensor and ground < 0.2 ohms	Key ON

Fault Overview

Fault code sets when the Body Controller detects low signal voltage from the fuel level sensor circuit for more than one second.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel level sensor signal circuit short to GND
- Failed fuel level sensor

Step 1	Verify that Body Controller (BC) is communicating.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check that BC is listed in Sniffer section. Is Body Controller listed?		Yes: Diagnose fuel level circuit fault. See appropriate Truck Service Manual. After repairs are complete, retest for SPN 96 FMI 4.
		No: Repair Body Controller fault. After repairs are complete, retest for SPN 96 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 96 FMI 4 fault code diagnostics.

SPN 96 FMI 19 - Fuel Level not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel level signal message not present on J1939 bus	Fuel level signal message not present	Key ON

Fault Overview

Fault code sets when Body Controller detects no fuel level signal message.

Lamp Reaction

None.

Associated Faults

None.

Fault Facts

None.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel level sensor signal circuit Open or high resistance
- Fuel level sensor GND circuit Open or high resistance
- Fuel level sensor signal circuit short to PWR
- Fuel level sensor signal circuit short to GND
- Body Controller offline
- Failed fuel level sensor

Step 1	Verify that Body Controller (BC) is communicating.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check that BC is listed in Sniffer section. Is Body Controller listed?		Yes: Diagnose fuel level circuit fault (see appropriate Truck Service Manual). After repairs are complete, retest for SPN 96 FMI 19.
		No: Repair Body Controller fault. After repairs are complete, retest for SPN 96 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 96 FMI 19 fault code diagnostics.

IAHC (Intake Air Heater Control)

Overview of IAHC Group

SPN	FMI	Condition
729	3	IAHC short to PWR (page 1273)
729	4	IAHC short to GND (page 1277)
729	5	IAHC open load / circuit (page 1279)
729	18	IAH Monitor fault: Lack of Heat in the Intake Manifold (page 1284)

Overview

Intake Air Heater (IAH) system warms incoming air supply prior to cranking to aid cold engine starting during warm-up. IAH system also helps load engine during a Diesel Particulate Filter (DPF) regeneration.

SPN 729 FMI 3 - IAHC short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Heater Driver Relay is shorted to Battery, detected by ATIC chip that drives Relay	Voltage change at power stage output while Intake air heater is commanded OFF < 3.5 Volts for time 0.0000150 to 0.0000250 seconds	Key ON No Power stage faults on the SPI chip SPN/FMI 158/15 and 158/17 are NOT active

Fault Overview

Fault sets when ATIC chip that drives Intake Air Heater Control (IAHC) relay indicates relay is shorted to battery.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 158 FMI 15 and 17 (ECM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IAHC circuit short to PWR

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1273). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 729 FMI 3.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 729 FMI 3. Is EST DTC list SPN 729 FMI 3 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Intake Air Heater Control (IAHC) relay and connector inspection.	Decision
A. Key OFF. B. Disconnect IAHC relay. C. Check IAHC relay and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IAHC relay connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 729 FMI 3.

Pin-Point Tests (SPN 729 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6025
- Digital Multimeter (DMM)

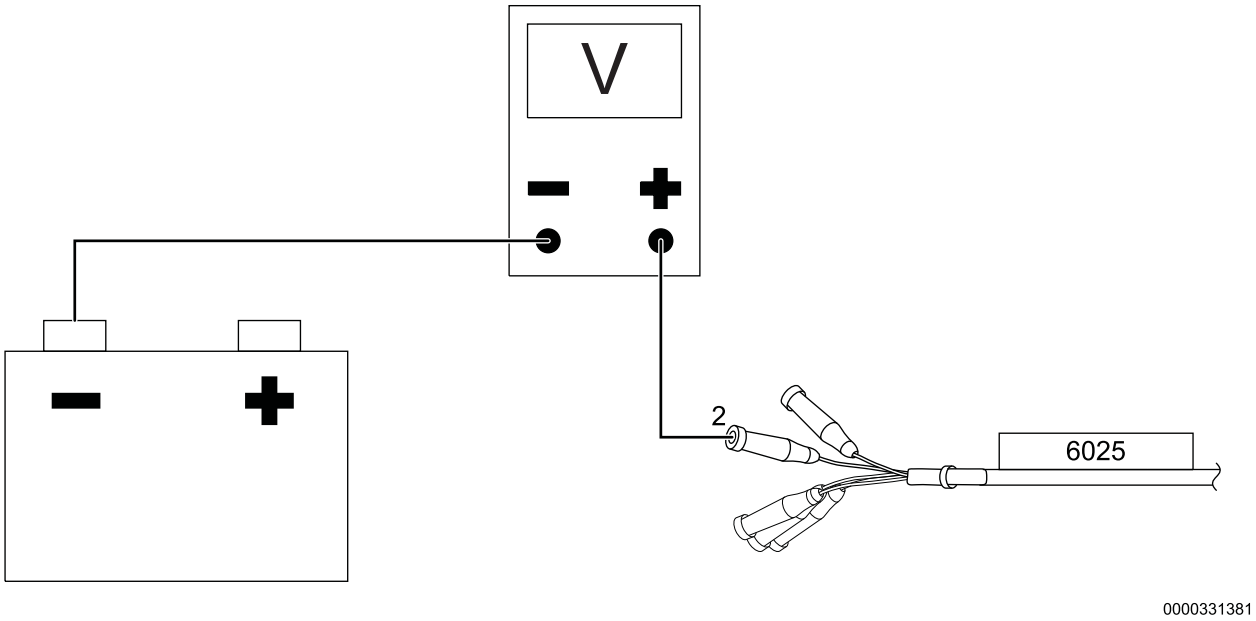


Figure 459 Test 1 Intake Air Heater Control (IAHC) relay Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect IAHC relay. C. Connect Breakout Harness ZTSE6025 to vehicle harness and leave IAHC relay disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6025 pin-2 and known good GND.	Less than 0.5 volts.
Decision	
Is voltage greater than 0.5 volts?	Yes: Replace IAHC Relay. After repairs are complete, retest for SPN 729 FMI 3.
	No: Repair short to PWR between ECM pin E-59 and IAHC Relay pin-2. After repairs are complete, retest for SPN 729 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 729 FMI 3 fault code diagnostics.

SPN 729 FMI 4 - IAHC short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
The Intake Air Heater Driver Relay is shorted to Ground, detected by the ATIC chip that drives the Relay	Current on the driver > 7 Amps for 50^{e-6} seconds or >14 Amps for 5^{e-6} seconds	Key ON No Power stage faults on the SPI chip SPN/FMI's 158/15 and 158/17 are NOT active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

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CONTENT
UNDER
DEVELOPMENT

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See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 729 FMI 5 - IAHC open load / circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Heater Driver Relay is Open Circuit, detected by Engine Control Module that drives Relay	Current on the driver < 8^{e-3} to 40^{e-3} Amps within 4^{e-3} seconds when gate is turned ON	Key ON No Power stage faults on the SPI chip SPN/FMI's 158/15 and 158/17 are NOT active

Fault Overview

Fault is set when Engine Control Module (ECM) detects Intake Air Heater (IAHC) Driver Relay is Open Circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 158 FMI 15 and 17 (ECM PWR)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in ACT GND circuit
- Open in IAHC circuit
- Failed IAH relay

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1279). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 729 FMI 5.

Step 2	Inspect connections Intake Air Heater (IAHC) Relay.	Decision
A. Key OFF B. Disconnect IAHC Relay. Check IAHC Relay and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IAHC Relay connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 729 FMI 5.

Pin-Point Tests (SPN 729 FMI 5)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6025
- Digital Multimeter (DMM)

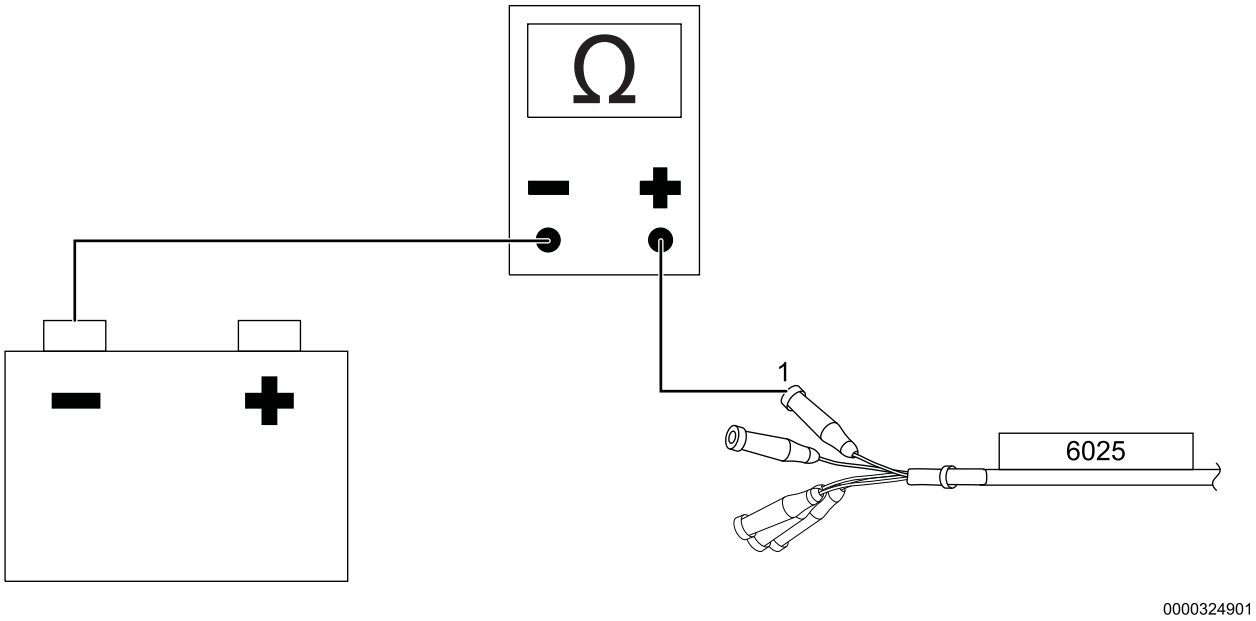
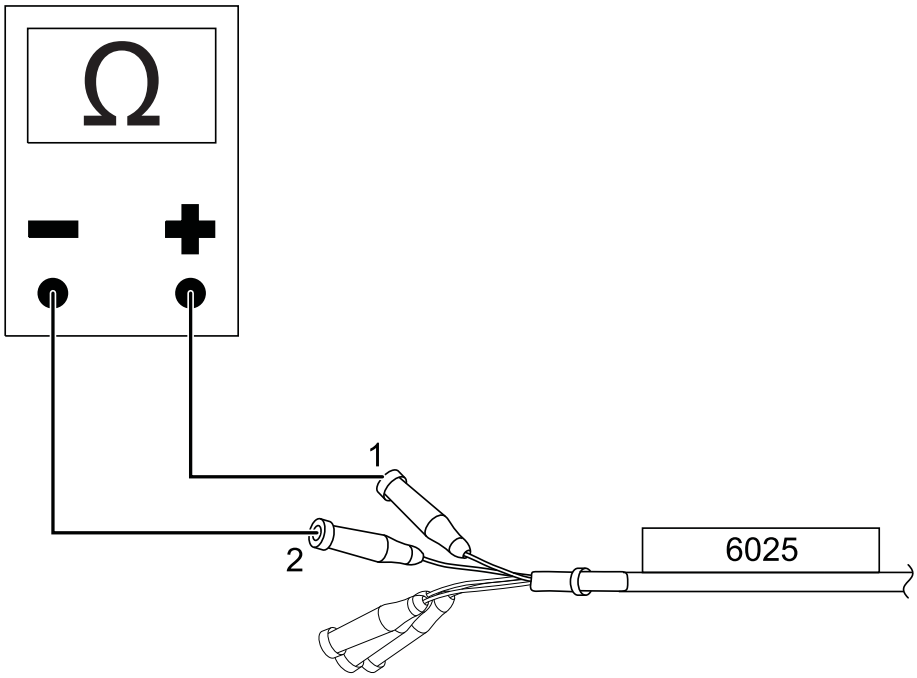


Figure 461 Test 1 Intake Air Heater (IAHC) Relay Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect ACM J2 connector. C. Connect breakout harness ZTSE6025 to vehicle harness and leave Intake Air Heater (IAHC) Relay disconnected D. Key ON.

Test 1	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6025 pin-1 and known good GND.	Less than 5 ohms.
Decision	
Is resistance less than 5 ohms?	Yes: Go to Test 2.
	No: Repair Open between IAH relay pin-2 and GND. After repairs are complete, retest for SPN 729 FMI 5.



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Figure 462 Test 2 Intake Air Heater (IAHC) Relay Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect ACM J2 connector. C. Connect breakout harness ZTSE6025 to vehicle harness and leave Intake Air Heater (IAHC) Relay disconnected D. Key ON.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness ZTSE6025 pin-1 and pin-2.	200 ± 100 ohms.
Decision	
Is resistance 200 ± 100 ohms?	Yes: Repair Open between IAH relay pin-2 and ECM pin E-59. After repairs are complete, retest for SPN 729 FMI 5.
	No: Replace IAH relay. After repairs are complete, retest for SPN 729 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 729 FMI 5 fault code diagnostics.

SPN 729 FMI 18 - IAH Monitor fault: Lack of Heat in the Intake Manifold

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Heater Rationality Monitor	Highest value of Engine Intake Manifold Temperature measured within the monitoring window MINUS Intake Manifold Temperature measured at "Key ON" condition > Threshold defined as a function of Engine Air Intake Temperature/Intake Air Heater 'ON' time (Table A079) [Monitoring window starts when { Intake Air Heater ON rising edge is detected OR Engine speed > 0 RPM} AND Ends after time] ≤ 20 seconds	Key ON Engine Throttle position command ≥ -100 % Engine exhaust recirculation valve command position ≤ 90 % [Engine Speed ≥ 100 RPM AND ≤ 3000 RPM for Percent time] ≥ 50 % Minimum time Intake Air Heater has been ON > 10 seconds NOT [Engine Air Intake Temperature < 100 °C AND Engine OFF timer > 0 seconds AND {Engine Coolant temperature sensor MINUS Engine Air Intake Temperature sensor}] > 5 °C SPN FMI's 102/3,102/4,729/3,729/4, 729/5, 105/3, and 105/4 are NOT active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

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CONTENT
UNDER
DEVELOPMENT

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See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

ICP Sensor (Injection Control Pressure)

Overview of ICP Sensor Group

SPN	FMI	Condition
164	0	ICP above KOEO Spec (page 1287)
164	1	ICP Unable to Build During Engine Cranking (page 1289)
164	3	ICP signal Out of Range HIGH (page 1291)
164	4	ICP signal Out of Range LOW (page 1301)
164	15	ICP too high during test (page 1306)
164	16	ICP above desired level (page 1309)
164	17	ICP unable to build during test (page 1314)
164	18	ICP below desired level (page 1318)

Overview

Injection Control Pressure (ICP) sensor provides feedback signal to Engine Control Module (ECM), indicating injection control pressure. ECM monitors ICP as engine is operating, to modulate Injection Pressure Regulator (IPR). This is a closed loop function in which ECM continuously monitors and adjusts for ideal ICP determined by conditions such as load, speed, and temperature.

SPN 164 FMI 0 - ICP above KOEO Specification

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Injection Control Pressure (ICP) Sensor Offset Check at Key Off condition	Engine ICP > 217.5 psi (1.5 MPa)	Engine Control Module in Power Latch Mode (Engine is stopped; KEY OFF) Time delay after engine has stopped ≥ 2.55 seconds SPN/FMI's: 164/3, 164/4, 3509/3, 3509/4 are NOT active

Fault Overview

Fault sets when Engine Control Module (ECM) detects Injection Control Pressure (ICP) sensor is offset during check at Key OFF condition.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 3 and 4 (ICP)	• SPN 3509 FMI 3 and 4 (VREF 1)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Injection Control Pressure (ICP) sensor

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1287). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 0.

Step 2	Measure Injection Control Pressure (ICP).	Decision
A. Key-On Engine-Off (KOEO). B. Using EST with ServiceMaxx™, measure ICP. Is ICP greater than 217.5 psi (1.5 MPa)?		Yes: Replace ICP sensor. No: Diagnostics complete.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 164 FMI 0 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 1 - ICP Unable to Build During Engine Cranking

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Injection Control Pressure (ICP) is low during engine start.	ICP < 3.5 MPa	Key ON Number of engine revolutions to begin monitoring ≥ 15 revolutions, and monitoring ends after engine is running for ≥ 30 seconds Inactive: SPN 164 FMI 3 and 4 (ICP); and SPN 679 FMI 3 and 4 (IPR)

Fault Overview

Fault code sets when Injection Control Pressure (ICP) is lower than 3.5 MPa while engine is cranking for 2.5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 3 and 4 (ICP)	• SPN 679 FMI 3 and 4 (IPR)		

Fault Facts

Must perform Key-On Engine-Off (KOEO) procedure Fuel Pressure Adaptation Reset (page 2117)in ServiceMaxx™ after repairs are complete. Make sure to remove and clean the High-Pressure (HP) oil rail and HP oil hose and fittings to remove contamination or debris if High-Pressure Oil Pump (HPOP) is replaced due to pump failure.

Drive Cycle to Determine Fault Status

Cranking

Possible Causes

- High-Pressure Oil Pump (HPOP)
- Restricted HPOP intake screen clogged
- Failed Injection Pressure Regulator (IPR) hydraulic and mechanical issues
- High-pressure oil leaks
- Failed fuel injectors
- IPR electrical circuit failures
- HP oil leaks at fuel injectors

Step 1	Check for associated faults.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1289). Is EST DTC free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 1.

Step 2	Check for active fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 164 FMI 1 (ICP). Does EST DTC show fault code SPN 164 FMI 1 as Active or Pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check engine oil level.	Decision
Perform Engine Oil and Quality Check (page 2353). Is engine oil level within specifications and not contaminated?		Yes: Go to Step 4. No: Repair engine oil level and / or contamination symptom. After repairs are complete, retest for SPN 164 FMI 1.

Step 4	Inspect High-Pressure Oil Pump (HPOP) pump reservoir.	Decision
Loosen Engine Oil Temperature (EOT) sensor and verify that the HPOP reservoir has oil in it. Does the HPOP reservoir have oil in it?		Yes: Go to Step 5. No: Diagnose lubrication system.

Step 5	Test HPOP.	Decision
Perform Cylinder Performance Analyzer (CPA) High-Pressure Oil Pump (HPOP) Test (page 2227). Follow on-screen instructions for test. When repairs are complete, perform the Fuel Pressure Adaptation Reset (page 2117)procedure.		

End Diagnostic Steps
After performing all diagnostic steps, if SPN 164 FMI 1 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 3 - ICP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Injection Control Pressure (ICP) signal is out of range high.	ICP sensor voltage > 4.9 volts (> 5096.6 psi [35.14 MPa])	Key ON Inactive: SPN 3509 FMI 3 and 4 (VREF1)

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Injection Control Pressure (ICP) signal greater than 4.9 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

Locking tabs on Injection Control Pressure (ICP) sensor connector fully seated.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ICP circuit Open
- ICP circuit short to PWR
- VREF1 circuit Open
- SIG GND circuit Open
- Damaged Under Valve Cover (UVC) harness
- Failed ICP sensor
- Broken Locking tab on harness connector

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1291). Is EST DTC list free of Associated Faults?		Yes: Repair Associated Faults. After repairs are complete, retest for SPN 3509 FMI 3 and FMI 4.
		No: Go to Step 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 164 FMI 3. Is EST DTC list SPN 164 FMI 3 active or pending?		Yes: Go to Step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect Under Valve Cover (UVC) connector.	Decision
A. Key OFF. B. Disconnect UVC connector. C. Check UVC connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests .
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 164 FMI 3.

Step 4	Inspect Under Valve Cover (UVC) under valve connector.	Decision
A. Key OFF. B. Disconnect UVC valve harness connector. C. Remove valve cover. D. Check UVC harness connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC harness connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests Test 5.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 164 FMI 3.

Pin-Point Tests (SPN 164 FMI 3)

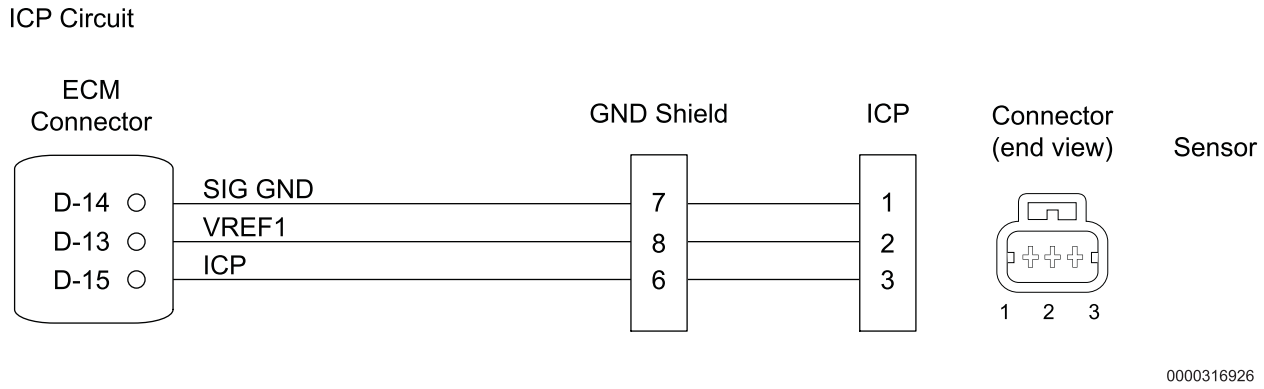


Figure 464 Injection Control Pressure (ICP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4498
- Breakout Harness ZTSE4686
- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

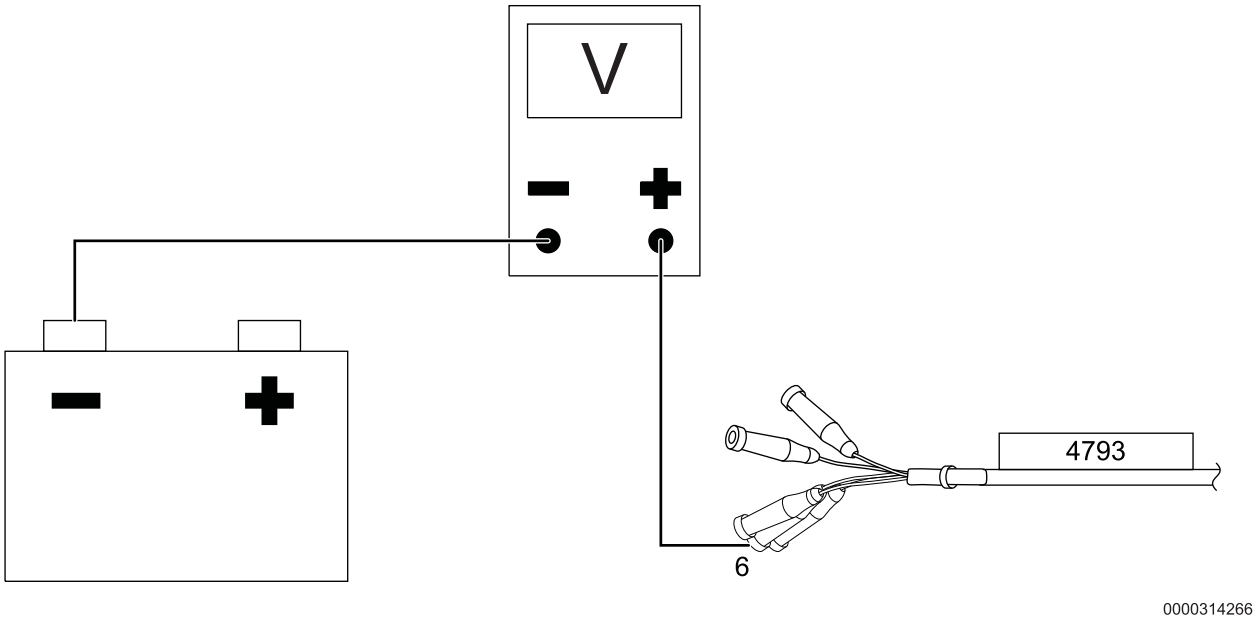


Figure 465 Test 1 Injection Control Pressure (ICP) Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4793 to vehicle harness and leave Under Valve Cover (UVC) harness disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4793 pin-6 and known good ground.	Greater than 5.5 volts
Decision	
Is voltage greater than 5.5 volts?	Yes: Repair short to PWR between UVC pin-6 and Engine Control Module (ECM) pin D-15. After repairs are complete, retest for SPN 164 FMI 3.
	No: Go to Test 2.

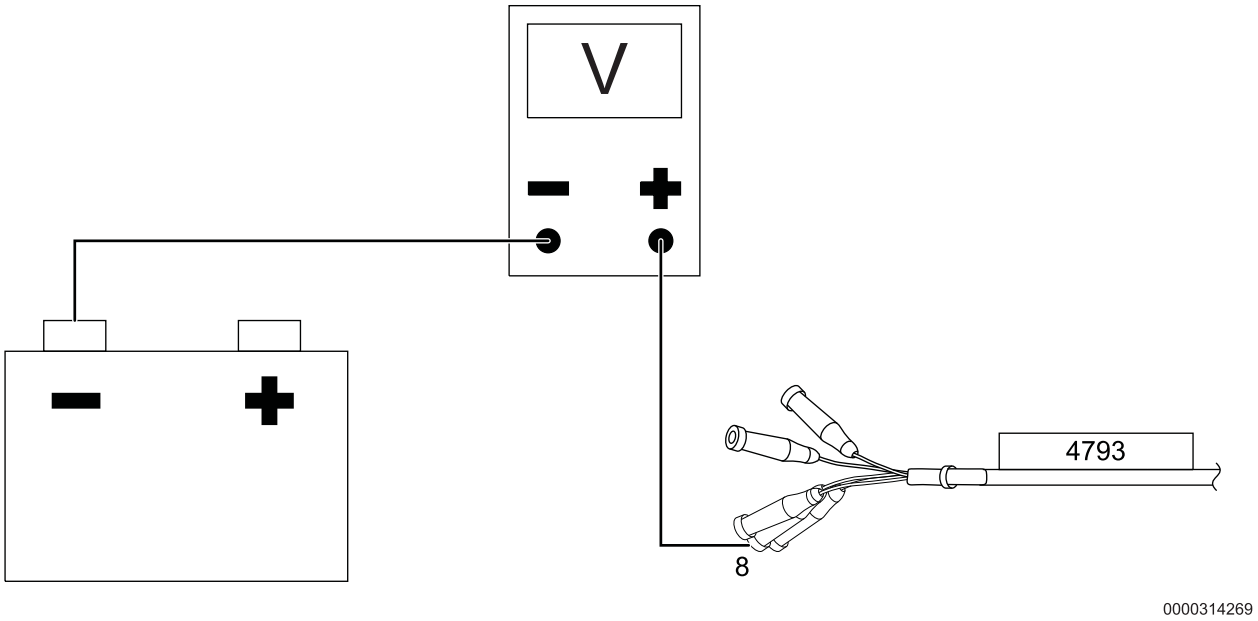
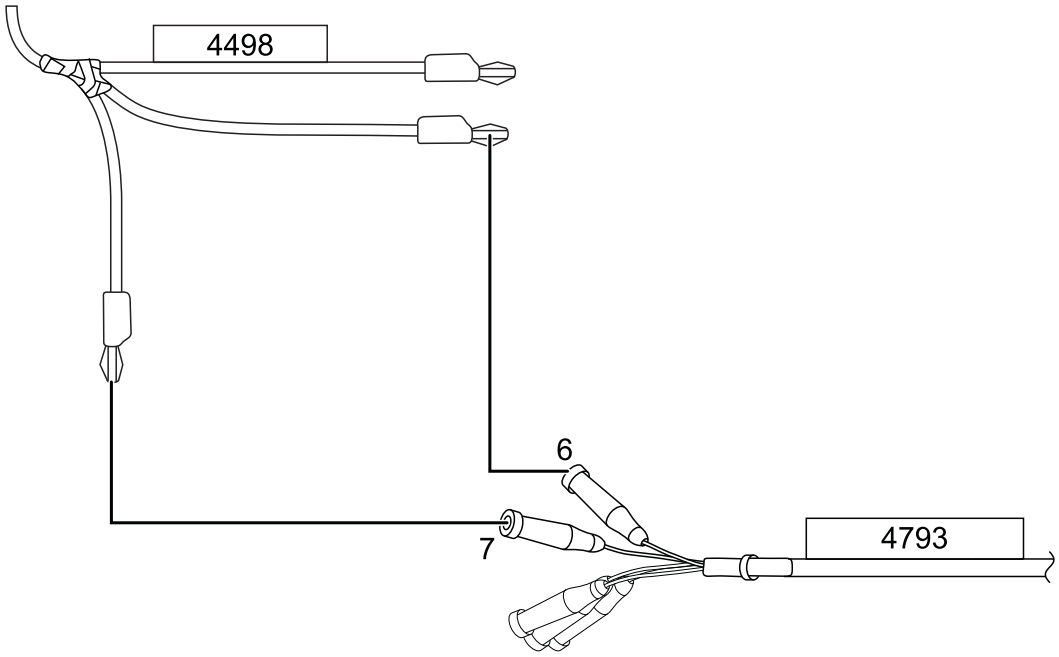


Figure 466 Test 2 Injection Control Pressure (ICP) Sensor Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4793 to vehicle harness and leave Under Valve Cover (UVC) harness disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4793 pin-8 and known good ground.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Go to Test 3.
	No: Repair Open between UVC pin-8 and ECM pin D-13. After repairs are complete, retest for SPN 164 FMI 3.



0000317901

Figure 467 Test 3 Injection Control Pressure (ICP) Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4793 to vehicle harness and leave Under Valve Cover (UVC) harness disconnected. C. Using breakout harness ZTSE4498, short pin-6 and pin-7 of breakout harness ZTSE4793 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124) E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™, clear Diagnostic Trouble Code (DTC) list.	SPN 164 FMI 4 sets in DTC list.
Decision	
Does SPN 164 FMI 4 set after DTC list is cleared	Yes: Go to step based Step 4.
	No: Go to Test 4.

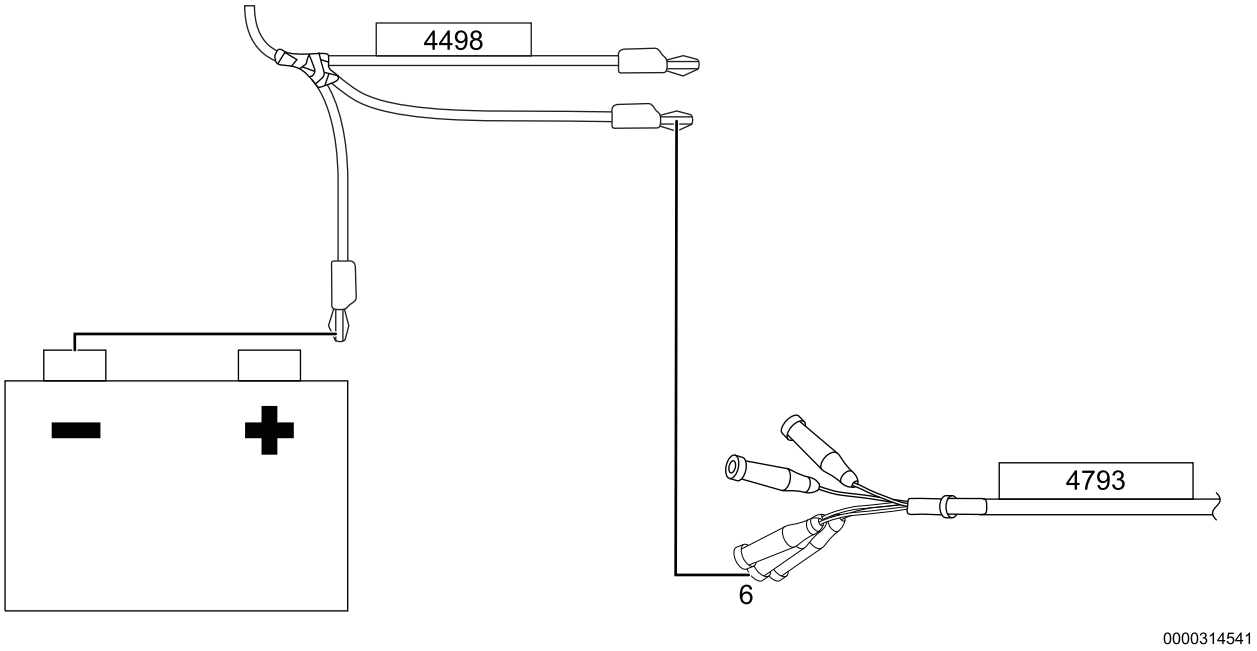


Figure 468 Test 4 Injection Control Pressure (ICP) Sensor Circuit Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4793 to vehicle harness and leave Under Valve Cover (UVC) harness disconnected. C. Using breakout harness ZTSE4793, short pin-6 to known good GND. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124) E. Key ON. Log in to ServiceMaxx™ software.

Test 4	Specification
Using EST with ServiceMaxx™, clear Diagnostic Trouble Code (DTC) list.	SPN 164 FMI 4
Decision	
Does SPN 164 FMI 4 set after DTC list is cleared?	Yes: Repair Open between UVC pin-7 and ECM pin D-14. After repairs are complete, retest for SPN 164 FMI 3.
	No: Repair Open between UVC pin-6 and ECM pin D-15. After repairs are complete, retest for SPN 164 FMI 3.

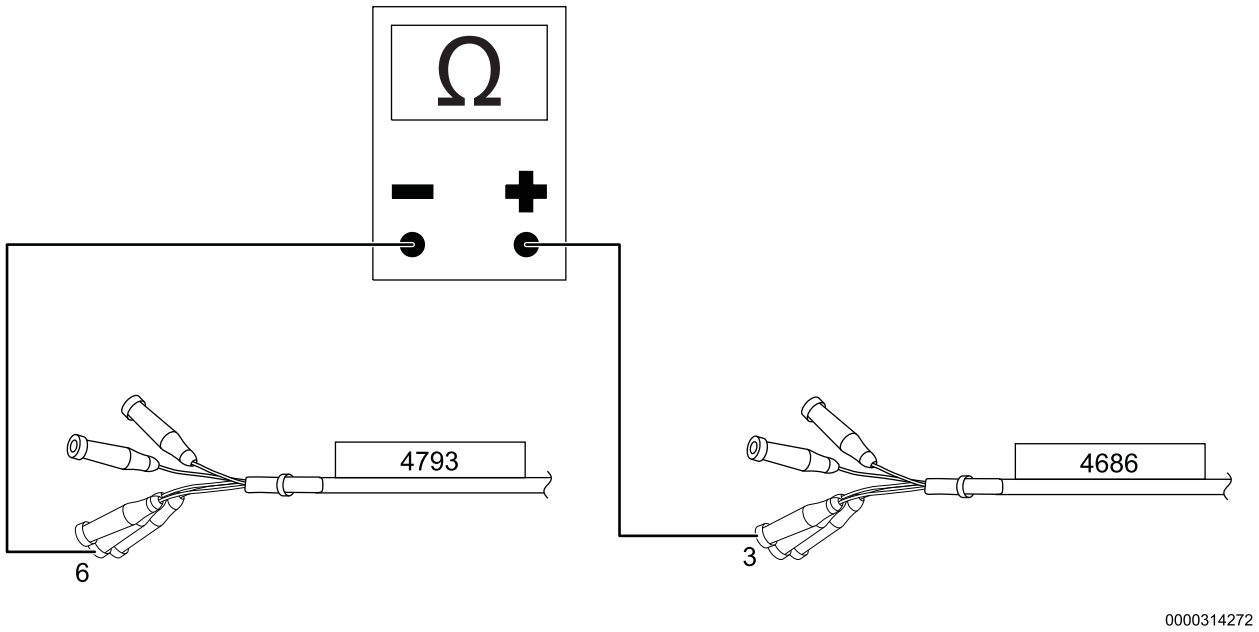


Figure 469 Test 5 Injection Control Pressure (ICP) Sensor Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Remove valve cover (*See Engine Service Manual*). C. Connect Breakout Harness ZTSE4793 to UVC harness and leave vehicle harness disconnected. D. Connect Breakout Harness ZTSE4686 to UVC harness leave Injection Control Pressure (ICP) sensor disconnected.

Test 5	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4793 pin-6 and Breakout Harness ZTSE4686 pin-3.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Step 6.
	No: Replace UVC harness. After repairs are complete, retest for SPN 164 FMI 3.

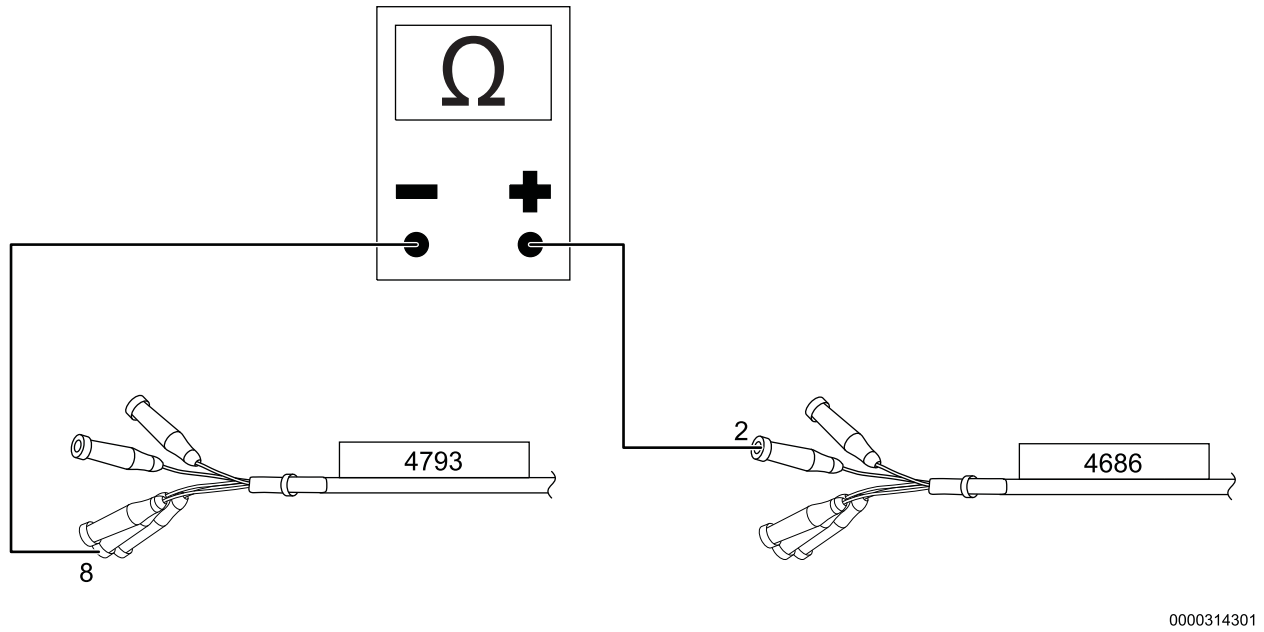


Figure 470 Test 6 Injection Control Pressure (ICP) Sensor Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Remove valve cover (*See Engine Service Manual*). C. Connect Breakout Harness ZTSE4793 to UVC harness and leave vehicle harness disconnected. D. Connect Breakout Harness ZTSE4686 to UVC harness and leave Injection Control Pressure (ICP) sensor disconnected.

Test 6	Specification
Use DMM to measure resistance between Breakout Harness ZTSE4793 pin-8 and Breakout Harness ZTSE4686 pin-2.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Go to Step 8.
	No: Replace UVC harness. After repairs are complete, retest for SPN 164 FMI 3.

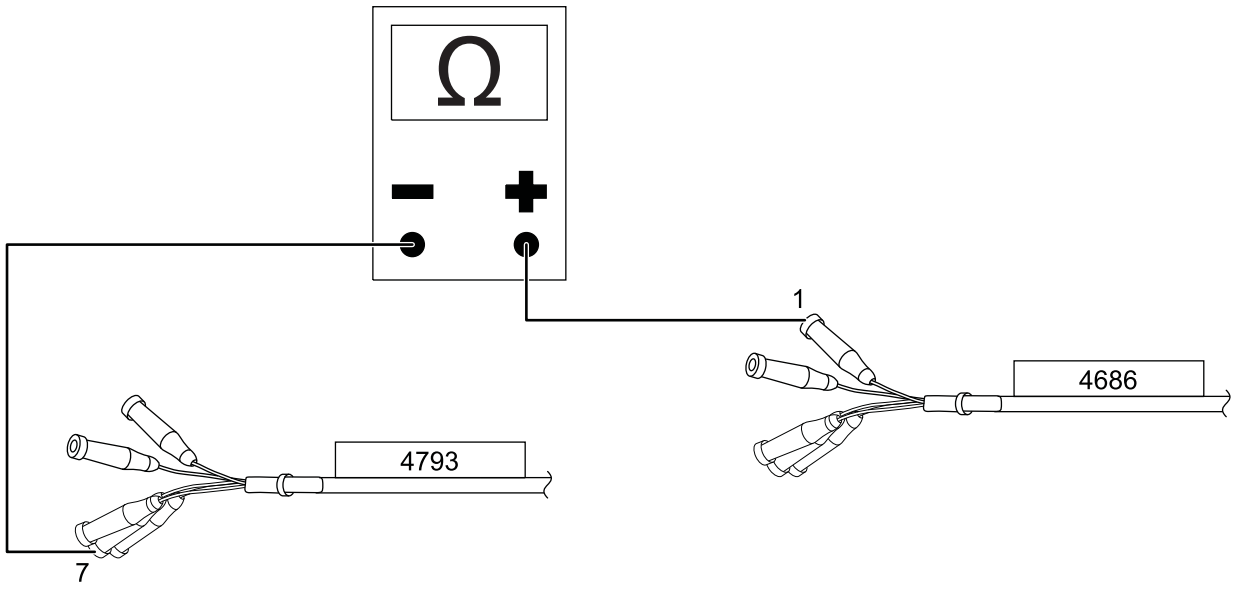


Figure 471 Test 7 Injection Control Pressure (ICP) Sensor Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Remove valve cover (*See Engine Service Manual*). C. Connect Breakout Harness ZTSE4793 to UVC harness and leave vehicle harness disconnected. D. Connect Breakout Harness ZTSE4686 to UVC harness leave Injection Control Pressure (ICP) sensor disconnected.

Test 7	Specification
Use DMM to measure resistance between Breakout harness ZTSE4793 pin-7 and Breakout Harness ZTSE4686 pin-1.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Replace ICP sensor. After repairs are complete, retest for SPN 164 FMI 3.
	No: Replace UVC harness. After repairs are complete, retest for SPN 164 FMI 3.

End Diagnostic Tests
After performing diagnostic steps, if SPN 164 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 4 - ICP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Injection Control Pressure (ICP) sensor signal is Out of Range Low.	ICP sensor voltage < 0.1 volt (< -1.133 MPa)	Key ON Inactive: SPN 3509 FMI 3 and 4

Fault Overview

Fault code sets when Injection Control Pressure (ICP) sensor signal is less than 0.1 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- ICP circuit short to GND
- Failed ICP sensor

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1301). Does EST DTC list show Associated Faults as active?		Yes: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 4.
		No: Go to Step 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 164 FMI 4. Is EST DTC list SPN 164 FMI 4 active or pending?		Yes: Go to Step 3.
		No: Go to intermittent diagnostic procedures (page 2123).

Step 3	Inspect connections at Under Valve Cover (UVC) harness connector for ICP sensor.	Decision
A. Key OFF. B. Disconnect UVC harness connector for ICP. C. Check UVC harness and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC harness connector for ICP and connector terminals clean and undamaged?		No: Perform Pin-Point Test .
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 164 FMI 4.

Pin-Point Tests (SPN 164 FMI 4)

ICP Circuit

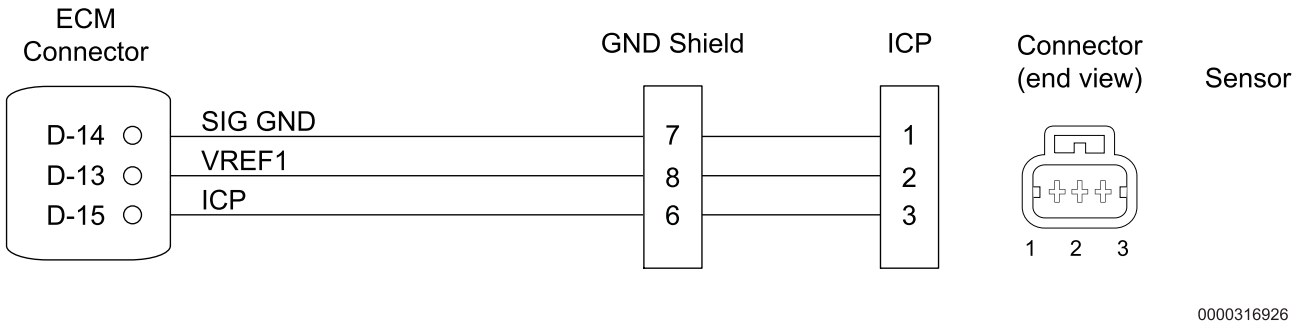


Figure 472 ICP Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793 (UVC)
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
• Key OFF. • Disconnect Under Valve Cover (UVC) harness for ICP sensor connector and leave disconnected. • Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). • Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Disconnect UVC harness connector for ICP, use EST with ServiceMaxx™ software to monitor Diagnostic Trouble Code (DTC) list for SPN 164 FMI 4.	SPN 164 FMI 4
Decision	
Is fault code SPN 164 FMI 4 active?	Yes: Correct short to GND between UVC vehicle harness for ICP pin-6 and Engine Control Module (ECM) pin D-15.
	No: Go to Test 2.

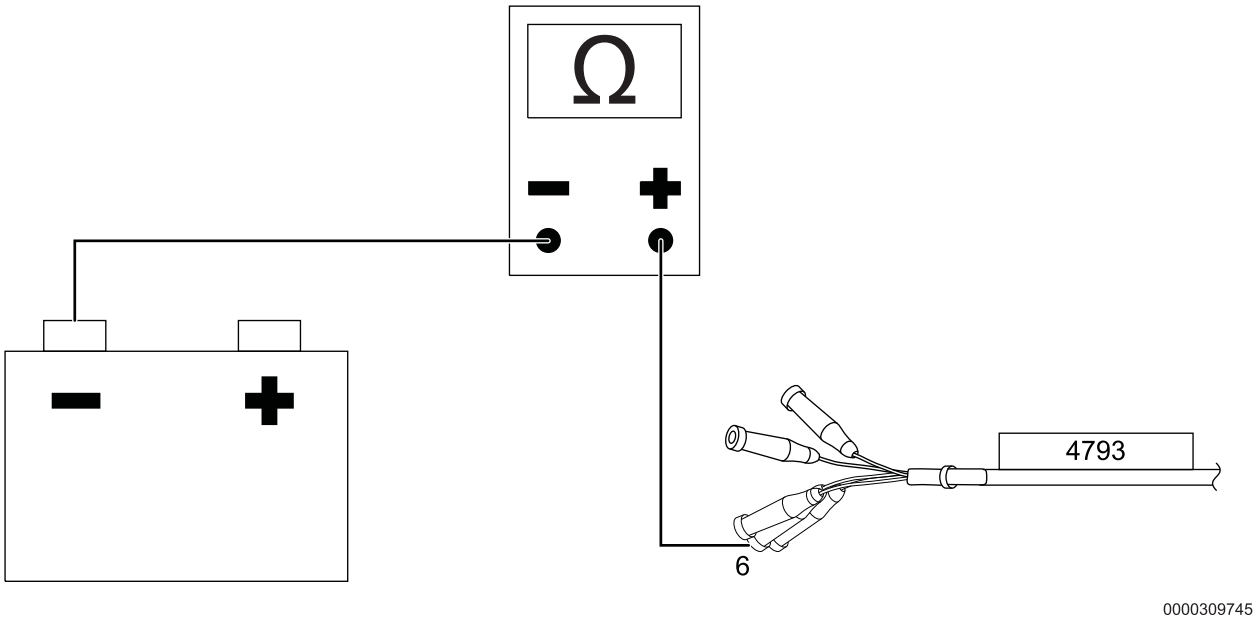


Figure 473 Pin-Point Test 2 ICP Sensor Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Connect Breakout harness ZTSE4793 to UVC engine harness connector that leads under valve cover and leave vehicle harness disconnected.

Test 2	Specification
Use DMM to measure resistance of between Breakout Harness ZTSE4793 pin-6 and known good ground.	0 ohms
Decision	
Is resistance approximately 0 ohms?	Yes: Repair short to GND between UVC vehicle harness for ICP pin-6 and Engine Control Module (ECM) pin D-15. After repairs are complete, retest for SPN 164 FMI 4.
	No: Replace ICP sensor. After repairs are complete, retest for SPN 164 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 164 FMI 4 fault code diagnostics.

SPN 164 FMI 15 - ICP too high during test

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

TBD

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 1, 3, and 4 (ICP)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 3055 FMI 2 (INJ)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Injection Pressure Regulator (IPR) valve
- Contaminated Oil

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1306). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 15.

Step 2	Inspect vehicle history for high-pressure oil system repairs	Decision
Determine if vehicle history included high-pressure oil system repairs. Were high-pressure oil system repairs recently performed?		Yes: Perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). No: Go to Step 3.

Step 3	Check for engine oil problems.	Decision
Check engine oil level and condition. Is engine oil at proper level and in good condition?		Yes: Go to Step 4. No: Correct / repair engine oil problems. After repairs are complete, retest for SPN 164 FMI 15.

Step 4	Test High-Pressure Oil Pump (HPOP) IPR electrical circuit.	Decision
Perform Cylinder Performance Analyzer (CPA) - HPOP(page 2227) Test. Does HPOP Test detect a problem with the IPR valve electrical circuit?		Yes: Repair IPR circuit. After repairs are complete, retest for SPN 164 FMI 15. No: Go to Step 5.

Step 5	Mechanically test the IPR valve hydraulic circuit.	Decision
Perform CPA - HPOP(page 2227) Test. Does HPOP Test detect a problem with the IPR valve hydraulic circuit?		Yes: Replace IPR valve and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 15. No: Diagnostics complete.

End Diagnostic Steps
After performing diagnostic steps, if SPN 164 FMI 15 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 16 - ICP above desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of measured Injection Control Pressure (ICP) value versus set point.	Engine ICP set point MINUS measured engine ICP ≥ threshold value based on speed / torque (Table A083)	1. Engine Injection Control Pressure in Close Loop Mode {Always in Close loop mode except when Limp Home mode is active} 2. Engine Oil Temperature (EOT) ≥ 95°F and ≤ 244°F (≥ 35°C and ≤ 118°C) Delay timer to activate diagnostics after entry conditions 1 and 2 mentioned above are met ≥ 15 seconds End of Line tests not active Engine Exhaust Brake or Vehicle Retarder NOT active Time after Engine Exhaust Brake or Vehicle Retarder state of change to not active > 5 seconds Torque limiting in Limp Home Mode is NOT active Fuel cut off in engine deceleration NOT active Battery voltage ≥ 9 volts and ≤ 16 volts Key ON Time after engine start is ≥ 30 seconds Engine Coolant Temperature (ECT) ≥ 68°F (20°C) AND ≤ 219°F (104°C) 132/3, 132/4, 636/7, 636/2, 110/3, 110/4, 110/2, 175/3, 175/4, 175/2, 164/0, 164/3, 164/4, 679/4, 679/3, 651/4, 651/5, 655/4, 652/5, 653/4, 653/5, 656/4, 654/5, 652/4, 655/5, 654/4, 656/5, 5543/3, 5543/5, 5543/4, 94/3, 94/4, 1189/3, 1189/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3, 2791/4, 5395/0, 5395/1, 2659/20, 4766/10, 110/17, 3055/2, 4257/7, 4257/7, 4257/7, 4257/7, 4257/7, 4257/7, and 4257/7 are NOT active

Fault Overview

None

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 1, 3, and 4 (ICP)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 3055 FMI 2 (INJ)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted High-Pressure Oil Pump (HPOP) intake screen
- Failed HPOP
- Injection Pressure Regulator (IPR) electrical circuit
- Failed IPR
- Leaks in High-Pressure (HP) oil system
- Failed injectors and pucks

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1310). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 16.

Step 2	Inspect vehicle history for High-Pressure (HP) oil system repairs	Decision
Determine if the vehicle history included HP oil system repairs. Were HP oil system repairs recently performed?		Yes: Perform the Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117) procedure. No: Go to Step 3.

Step 3	Check for engine oil problems.	Decision
Check engine oil level and condition. Is engine oil at proper level and in good condition?		Yes: Go to Step 4. No: Repair engine oil problems. After repairs are complete, retest for SPN 164 FMI 16.

Step 4	Inspect High-Pressure Oil Pump (HPOP) reservoir.	Decision
Inspect HPOP reservoir for appropriate engine oil level. Remove Engine Oil Temperature (EOT) sensor. Does engine oil drain from HPOP reservoir?		Yes: Reinstall EOT sensor. Go to Step 5 No: Clean passages going to HPOP reservoir. After repairs are complete, retest for SPN 164 FMI 16.

Step 5	Test HPOP Injection Pressure Regulator (IPR) electrical circuit.	Decision
Perform Cylinder Performance Analyzer (CPA) - High-Pressure Oil Pump (HPOP)(page 2227) Test. Does HPOP Test detect a problem with the IPR valve electrical circuit?		Yes: Repair IPR circuit. After repairs are complete, retest for SPN 164 FMI 16. No: Go to Step 6.

Step 6	Mechanically test IPR valve hydraulic circuit.	Decision
Perform Cylinder Performance Analyzer (CPA) - High-Pressure Oil Pump (HPOP)(page 2227) Test. Does HPOP Test detect a problem with IPR valve hydraulic circuit?		Yes: Replace IPR valve and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 16.
		No: Go to Step 7.

Step 7	Perform dead head test of HPOP.	Decision
Perform Cylinder Performance Analyzer (CPA)- High-Pressure Oil Pump (HPOP)(page 2227) Test. Does HPOP test detect a problem with HPOP pump?		Yes: Go to Step 8.
		No: Go to Step 9.

Step 8	Inspect HPOP intake screen.	Decision
Remove HPOP pump and inspect intake screen for plugging and debris. Is debris plugging intake to HPOP?		Yes: Clean intake screen, repair source of debris, and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 16.
		No: Replace HPOP and perform KOEO Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 16.

Step 9	Inspect injector spool valve.	Decision
Inspect injector spool valve for debris. Is debris present?		Yes: Clean injector spool valve. After repairs are complete, retest for SPN 164 FMI 16.
		No: Go to Step 10.

Step 10	Perform Injector Test.	Decision
Using EST with ServiceMaxx™ software, perform the Injector Test (Buzz test)(page 2154) to ensure all injectors function properly. Do all injectors function properly?		Yes: Go to Step 11.
		No: Repair / replace failed injector(s) perform KOEO Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, go to Step 11.

Step 11	Inspect HP oil system	Decision
Inspect HP oil rail, HP oil hose, and elbow connections for contamination or debris. Are contaminates or debris found in HP oil system?		Yes: Clean high-pressure oil rail, high-pressure oil hose, and elbow connection. After repairs are complete retest for SPN 164 FMI 16
		Replace all 6 injectors, pucks, and seals. Perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 16

End Diagnostic Steps
After performing diagnostic steps, if SPN 164 FMI 16 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 17 - ICP unable to build during test

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

None

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 1, 3, and 4 (ICP)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 3055 FMI 2 (INJ)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted High-Pressure Oil Pump (HPOP) intake screen
- Failed HPOP
- Injection Pressure Regulator (IPR) electrical circuit
- Failed IPR
- Leaks in High-Pressure (HP) oil system
- Failed injectors and pucks

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1314). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 17.

Step 2	Inspect vehicle history for HP oil system repairs	Decision
Determine if the vehicle history included high-pressure oil system repairs. Were HP oil system repairs recently performed?		Yes: Perform the Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117) procedure. No: Go to Step 3.

Step 3	Check for engine oil problems.	Decision
Check engine oil level and condition. Is engine oil at proper level and in good condition?		Yes: Go to Step 4. No: Repair engine oil problems. After repairs are complete, retest for SPN 164 FMI 17.

Step 4	Inspect HPOP reservoir.	Decision
Inspect HPOP reservoir for appropriate engine oil level. Remove Engine Oil Temperature (EOT) sensor. Does engine oil drain from HPOP reservoir?		Yes: Reinstall EOT sensor. Go to Step 5 No: Clean passages going to HPOP reservoir. After repairs are complete, retest for SPN 164 FMI 17.

Step 5	Check HPOP IPR electrical circuit.	Decision
Perform Cylinder Performance Analyzer (CPA) - HPOP(page 2227) Test. Does HPOP Test detect a problem with the IPR valve electrical circuit?		Yes: Repair IPR circuit. After repairs are complete, retest for SPN 164 FMI 17. No: Go to Step 6.

Step 6	Mechanically test IPR valve hydraulic circuit.	Decision
Perform CPA - HPOP(page 2227) Test. Does HPOP Test detect a problem with IPR valve hydraulic circuit?		Yes: Replace IPR valve and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 17.
		No: Go to Step 7.

Step 7	Perform dead head test of HPOP.	Decision
Perform CPA - HPOP(page 2227) Test. Does HPOP test detect an issue with HPOP pump?		Yes: Go to Step 8.
		No: Go to Step 9.

Step 8	Inspect HPOP intake screen.	Decision
Remove HPOP pump and inspect intake screen for plugging and debris. Is debris plugging the intake to HPOP?		Yes: Clean intake screen, repair source of debris, and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 17.
		No: Replace HPOP and perform KOEO Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 17.

Step 9	Inspect injector spool valve.	Decision
Inspect injector spool valve for debris. Is debris present?		Yes: Clean injector spool valve. After repairs are complete, retest for SPN 164 FMI 17.
		No: Go to Step 10.

Step 10	Perform the Injector Test.	Decision
Using EST with ServiceMaxx™ software, perform the Injector Test (Buzz test)(page 2154) to ensure all injectors function properly. Do all injectors function properly?		Yes: Go to Step 11. No: Repair / replace failed injector(s) perform KOEO Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, go to Step 11.

Step 11	Inspect HP oil system	Decision
Inspect HP oil rail, HP oil hose, and elbow connections for contamination or debris. Are contaminates or debris found in HP oil system?		Yes: Clean HP oil rail, HP oil hose, and elbow connection. After repairs are complete retest for SPN 164 FMI 17 Replace all 6 injectors, pucks, and seals. Perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 17

End Diagnostic Steps
After performing diagnostic steps, if SPN 164 FMI 17 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 164 FMI 18 - ICP below desired level

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of measured Injection Control Pressure (ICP) value versus set point.	Engine ICP set point MINUS measured engine ICP < threshold value based on speed / torque (Table A084)	1. Engine Injection Control Pressure in Close Loop Mode {Always in Close loop mode except when Limp Home mode is active} Engine Oil Temperature (EOT) ≥ 95°F and ≤ 244.4°F (≥ 35°C and ≤ 118°C) Delay timer to activate diagnostics after entry conditions 1 and 2 mentioned above are met ≥ 15 seconds End of Line tests not active Engine Exhaust Brake or Vehicle Retarder NOT active Time after Engine Exhaust Brake or Vehicle Retarder state of change to not active > 5 seconds Torque limiting in Limp Home Mode is NOT active Fuel cut off in engine deceleration NOT active Battery voltage ≥ 9 volts and ≤ 16 volts Key ON Time after engine start is ≥ 30 seconds Engine Coolant Temperature (ECT) ≥ 68°F (20°C) AND ≤ 219°F (104°C) 132/3, 132/4, 636/7, 636/2, 110/3, 110/4, 110/2, 175/3, 175/4, 175/2, 164/0, 164/3, 164/4, 679/4, 679/3, 651/4, 651/5, 655/4, 652/5, 653/4, 653/5, 656/4, 654/5, 652/4, 655/5, 654/4, 656/5, 5543/3, 5543/5, 5543/4, 94/3, 94/4, 1189/3, 1189/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3, 2791/4, 5395/0, 5395/1, 2659/20, 4766/10, 110/17, 3055/2, 4257/7, 4257/7, 4257/7, 4257/7, 4257/7, 4257/7, and 4257/7 are NOT active

Fault Overview

TBD

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 164 FMI 1, 3, and 4 (ICP)	• SPN 3055 FMI 2 (INJ)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Include step to reset PP for ICP adaptation
- Fuel pressure adaptation necessary
- Failed Injection Pressure Regulator (IPR) valve
- High-Pressure Oil Pump (HPOP)

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1319). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 164 FMI 18.

Step 2	Inspect vehicle history for High-Pressure (HP) oil system repairs	Decision
Determine if vehicle history included HP oil system repairs. Were HP oil system repairs recently performed?		Yes: Perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). No: Go to Step 3.

Step 3	Check for engine oil problems.	Decision
Check engine oil level and condition. Is engine oil at proper level and in good condition?		Yes: Go to Step 4. No: Correct / repair engine oil problems. After repairs are complete, retest for SPN 164 FMI 18.

Step 4	Test HPOP Injection Pressure Regulator (IPR) electrical circuit.	Decision
Perform Cylinder Performance Analyzer (CPA) - HPOP(page 2227) Test. Does HPOP Test detect a problem with IPR valve electrical circuit?		Yes: Repair IPR circuit. After repairs are complete, retest for SPN 164 FMI 18. No: Go to Step 5.

Step 5	Mechanically test the IPR valve hydraulic circuit.	Decision
Perform CPA - HPOP(page 2227) Test. Does HPOP Test detect a problem with IPR valve hydraulic circuit?		Yes: Replace IPR valve and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset (page 2117). After repairs are complete, retest for SPN 164 FMI 18. No: Diagnostics complete.

End Diagnostic Steps
After performing diagnostic steps, if SPN 164 FMI 18 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

IMP (Intake Manifold Pressure)

Overview of IMP Sensor Group

SPN	FMI	Condition
102	2	IMP signal erratic, intermittent, or incorrect (page 1323)
102	3	IMP signal Out of Range HIGH (page 1326)
102	4	IMP signal Out of Range LOW (page 1331)
102	7	IMP signal not responding as expected (page 1337)
102	10	Boost slow response fault (page 1340)
102	16	Overboost (page 1343)
102	18	Underboost (page 1346)

Overview

Engine Control Module (ECM) uses Intake Manifold Pressure (IMP) sensor signal to assist in calculation of Exhaust Gas Recirculation (EGR) percentage. ECM monitors IMP signal to determine intake manifold (boost) pressure. From this information, CM can optimize fuel rate and injection timing for all engine operating conditions.

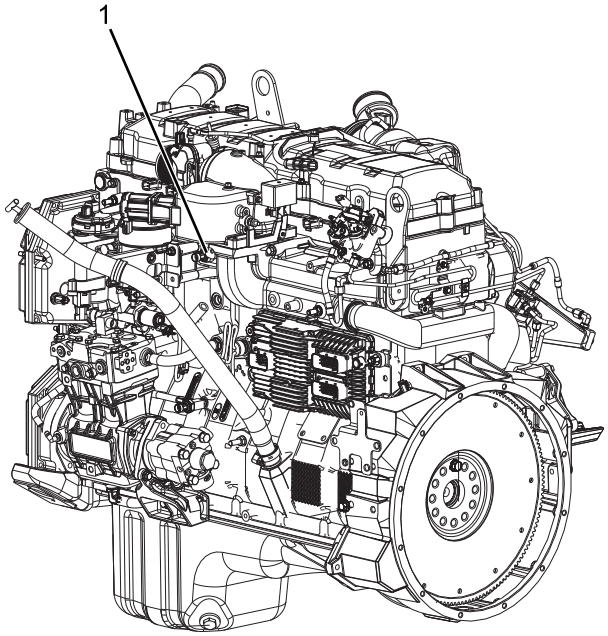


Figure 474 Intake Manifold Pressure (IMP) Sensor Location

1. IMP sensor

SPN 102 FMI 2 - IMP signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of Engine Intake Manifold #1 Pressure with Barometric Pressure and Engine Exhaust Gas Pressure	[Absolute value of difference between Engine Intake Manifold #1 pressure and Barometric Pressure > 4.4 psi (30 kPa) AND Absolute value of difference between Engine Intake Manifold # 1 Pressure and Engine Exhaust Gas Pressure > 4.4 psi (30 kPa) AND Absolute value of difference between Barometric pressure and Engine Exhaust Gas Pressure > 4.4 psi (30 kPa) AND Engine Wastegate Actuator Position Command] < 100%	Key ON Time after Key ON > 0 seconds Battery Voltage > 9 Volts AND < 16 Volts [1. Engine Speed < 50 RPM 2. Engine Fuel Mass Command < 10 mg/stk 3. Engine Wastegate Actuator Position Command < 100% 4. Engine Throttle position command < 10% 5. Engine Exhaust Gas Recirculation Valve Position Command < 40% Minimum time entry conditions (1) through (5) - mentioned above are satisfied] > 20 * 0.1 seconds OR [Engine Speed < 100 RPM AND Engine Fuel Mass Command] < 100 mg/stk SPN FMI 108/3,108/4, 1209/3,1209/4,102/3 and 102/4 are NOT active

Fault Overview

Fault sets when absolute pressure difference between Intake Manifold Pressure (IMP) and Barometric Absolute Pressure (BARO) and absolute pressure difference between IMP and Exhaust Gas Pressure (EGP) absolute pressure difference between EGP and BARO are greater than 4.4 psi (30 kPa) for two seconds with Wastegate Actuator Position Command is less than 100%.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

IMP sensor cannot be compared to other similar sensors in SMX, because Intake Manifold Pressure (IMP) values cannot be negative, and IMP value is in gauge units.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Defective sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1323). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 102 FMI 2.

Step 2	Check for active or pending fault code.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 102 FMI 2. Is EST DTC list SPN 102 FMI 2 active or pending?		Yes: Replace IMP sensor. After repairs are complete, retest for SPN 102 FMI 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Tests
After performing all diagnostic steps, if SPN 102 FMI 2 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 102 FMI 3 - IMP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Manifold Pressure (IMP) signal Out of Range HIGH.	IMP sensor voltage > 4.8 volts (89 psi [613.3 kPa])	Key ON SPN 3509 FMI 3 and 4 are not active

Fault Overview

Fault code sets when Intake Manifold Pressure (IMP) is greater than 4.8 volts (89 psi {613.3 kPa}) for 2.55 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IMP sensor signal circuit short to power
- Signal GND circuit Open
- Failed IMP sensor

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1326). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 102 FMI 3.

Step 2	Inspect connections at Intake Manifold Pressure (IMP) sensor.	Decision
A. Key OFF. B. Disconnect IMP sensor connector. C. Check IMP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IMP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 102 FMI 3.

Pin-Point Tests (SPN 102 FMI 3)

IMP Circuit

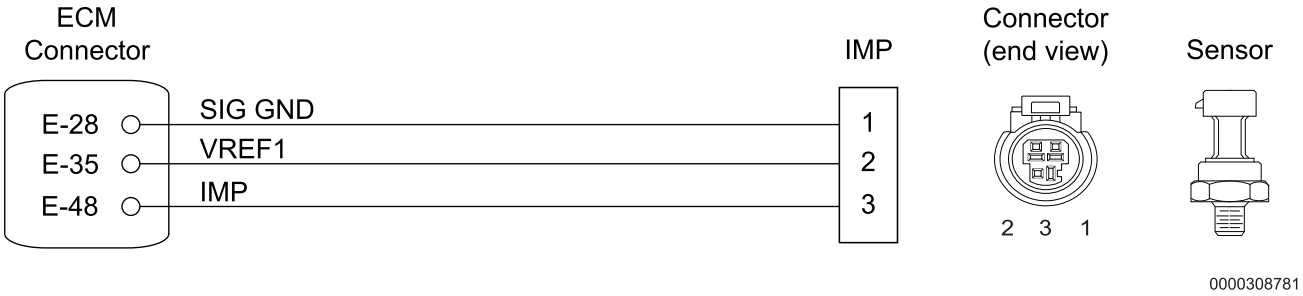


Figure 475 Intake Manifold Pressure (IMP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Intake Manifold Pressure (IMP) vehicle harness connector. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 102 FMI 3 sets in DTC list
Decision	
Does SPN 102 FMI 3 set after DTC list is cleared?	Yes: Repair short to power between IMP pin-3 and Engine Control Module (ECM) pin E-48. After repairs are complete, retest for SPN 102 FMI 3.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Intake Manifold Pressure (IMP) vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 2	Specification
Using DMM, measure voltage between Breakout Harness ZTSE4850 and B+.	B+
Decision	
Is voltage B+?	Yes: Replace IMP sensor. After repairs are complete, retest for SPN 102 FMI 3.
	No: Repair Open between IMP sensor pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 102 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 102 FMI 3 fault code diagnostics.

SPN 102 FMI 4 - IMP signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Manifold Pressure (IMP) signal Out of Range LOW.	IMP voltage < 0.1899 volt	Key ON. SPN 3509 FMI 3 and 4 are not active

Fault Overview

Fault sets when Intake Manifold Pressure (IMP) voltage is less than 0.1899 volts (4 psi {31 kPa}) for 2.55 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3509 FMI 3 and 4 (VREF 1)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Intake Manifold Pressure (IMP) signal circuit Open
- IMP signal circuit short to GND
- VREF 1 circuit Open
- Failed IMP sensor

WARNING: To prevent personal injury or death, stay clear of rotating parts (belts and fan) and hot engine surfaces.

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1331). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3509 FMI 3 and 4.

Step 2	Inspect connections at Intake Manifold Pressure (IMP) sensor.	Decision
A. Key OFF. B. Disconnect IMP sensor connector. C. Check IMP sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IMP sensor connector, harness, and terminal clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 102 FMI 4.

Pin-Point Tests (SPN 102 FMI 4)

IMP Circuit

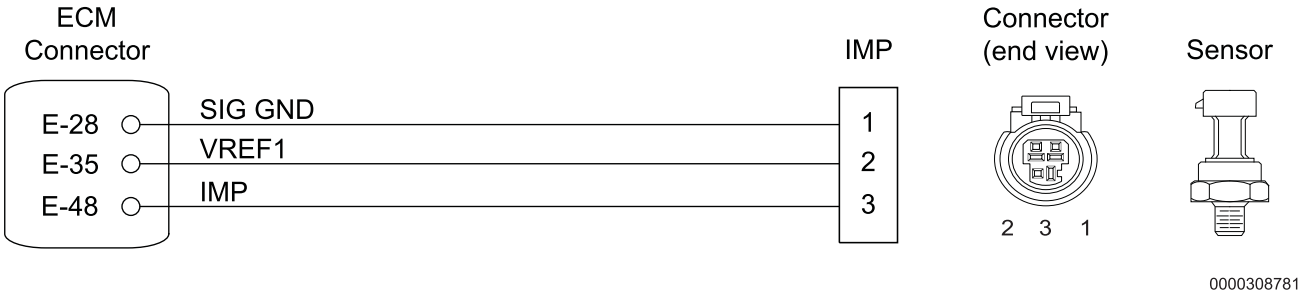


Figure 476 Intake Manifold Pressure (IMP) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

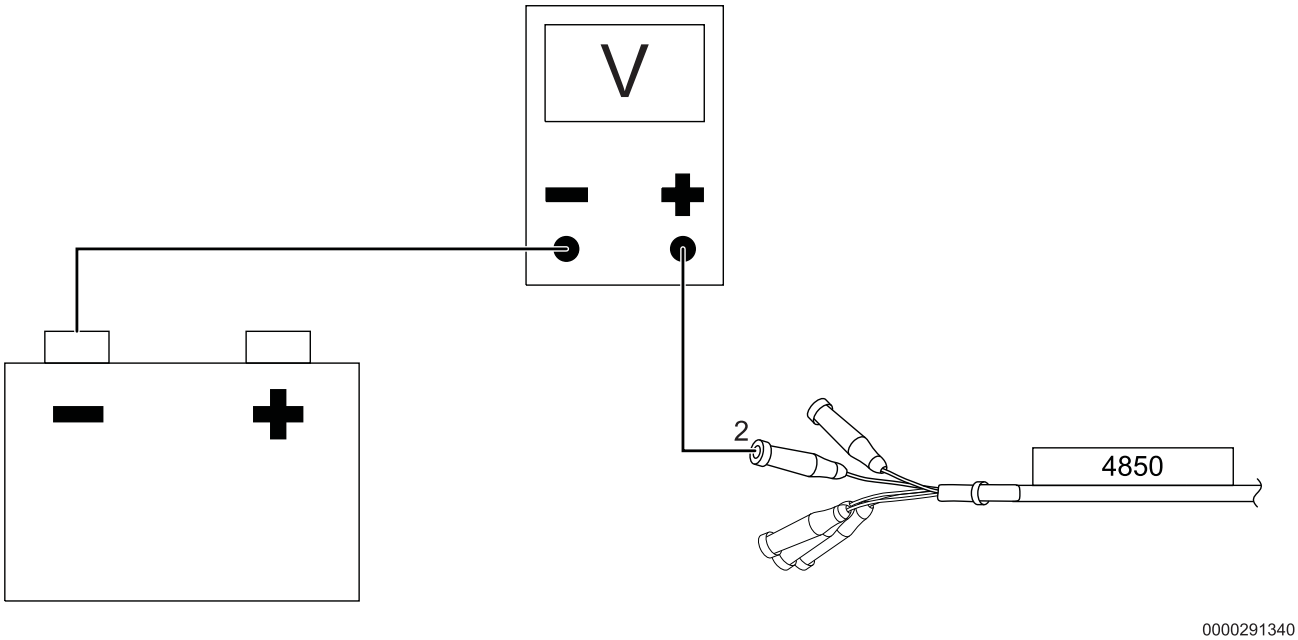
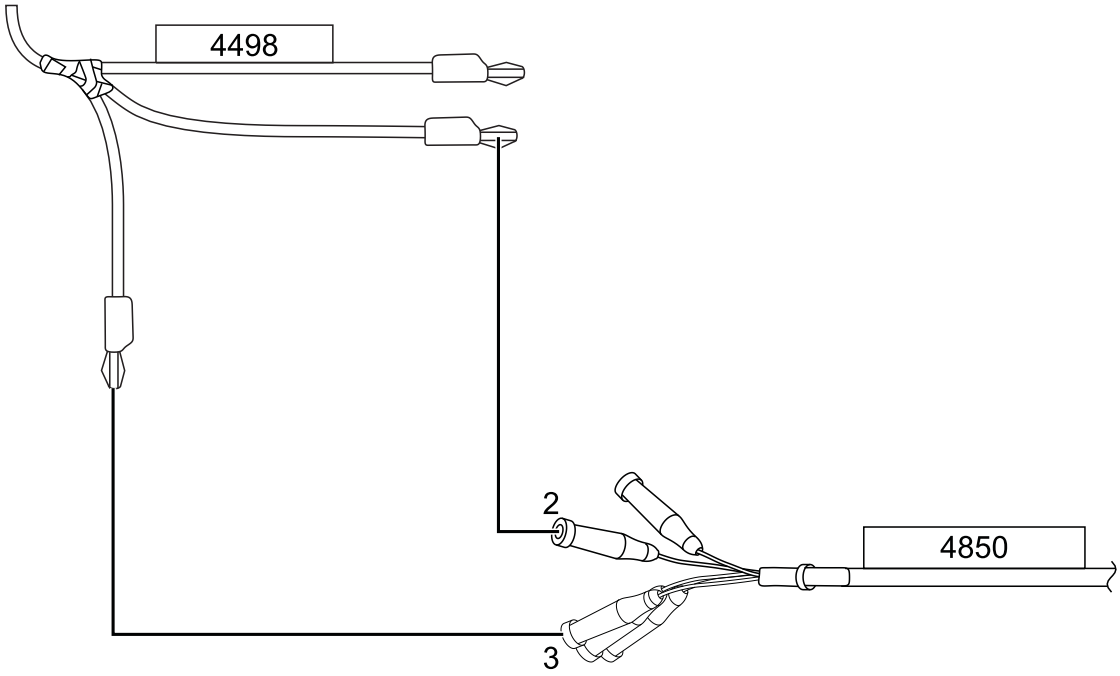


Figure 477 Test 1 Intake Manifold Pressure (IMP) Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Intake Manifold Pressure (IMP) vehicle harness connector and leave sensor disconnected. C. Key ON.

Test 1	Specification
Using DMM, measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.	5 ± 1 volts
Decision	
Is voltage 5 ± 1 volts?	Yes: Go to Test 2
	No: Repair Open between IMP pin-2 and Engine Control Module (ECM) pin E-35. After repairs are complete, retest for SPN 102 FMI 4.

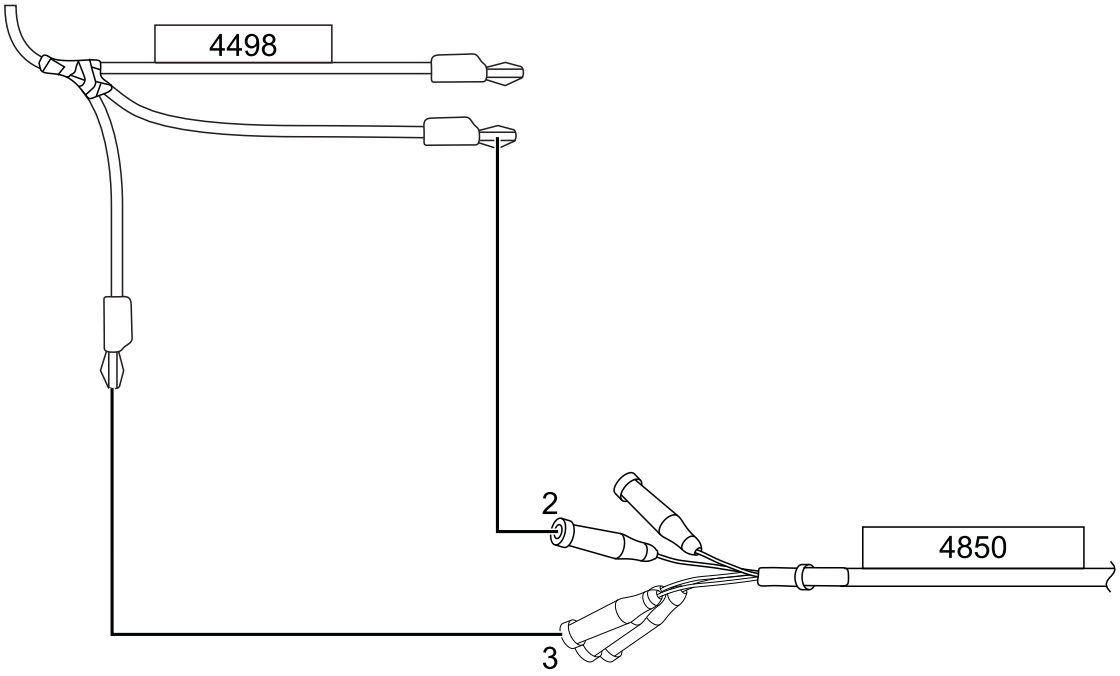


0000304541

Figure 478 Test 2 Intake Manifold Pressure (IMP) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Intake Manifold Pressure (IMP) vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 102 FMI 3 sets in DTC list
Decision	
Does SPN 102 FMI 3 set after DTC list is cleared?	Yes: Replace IMP sensor. After repairs are complete, retest for SPN 102 FMI 4.
	No: Go to Test 3.



0000304541

Figure 479 Test 3 Intake Manifold Pressure (IMP) Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4850 to Intake Manifold Pressure (IMP) vehicle harness connector and leave sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-2 and pin-3 of Breakout Harness ZTSE4850 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 3509 FMI 4 sets in DTC list.
Decision	
Does SPN 3509 FMI 4 set after DTC list is cleared?	Yes: Repair Short to ground between IMP pin-3 and Engine Control Module (ECM) pin E-48. After repairs are complete, retest for SPN 102 FMI 4.
	No: Repair Open between IMP pin-3 and ECM pin E-48. After repairs are complete, retest for SPN 102 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 102 FMI 4 fault code diagnostics.

SPN 102 FMI 7 - IMP signal not responding as expected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Intake Manifold #1 Pressure stuck in Range	Maximum Engine Intake Manifold #1 Pressure Value - Minimum Engine Intake Manifold #1 Pressure Value {Maximum and Minimum sensor values are measured as defined in entry conditions} < 50 kPa	1. Engine Speed Range for Minimum Intake Manifold Pressure calculation ≥ 650 RPM AND < 800 RPM 2. {Engine Turbocharger Wastegate Drive Set point for Minimum Intake Manifold Pressure calculation ≥ 0 % AND ≤ 100 % OR Engine Turbocharger Wastegate Drive feedback position for Minimum Intake Manifold Pressure calculation} ≥ 0 % AND ≤ 100 % 3. {Engine Exhaust Gas Recirculation Valve Set point for Minimum Intake Manifold Pressure calculation ≥ 0 % AND ≤ 100 % OR Engine Exhaust Gas Recirculation Valve feedback position for Minimum Intake Manifold Pressure calculation} ≥ 0 % AND ≤ 100 % 4. Engine Torque Set point range for Minimum Intake Manifold Pressure Value Calculation ≥ 40 N·m AND < 200 N·m 5. Engine Speed for Maximum Intake Manifold Pressure calculation ≥ 2000 RPM 6. {Engine Turbocharger Wastegate Drive Set point for Maximum Intake Manifold Pressure calculation ≥ 0 % AND ≤ 100 % OR Engine Turbocharger Wastegate Drive feedback position for Maximum Intake Manifold Pressure calculation} ≥ 0 % AND ≤ 100 % 7. {Engine Exhaust Gas Recirculation Valve Set point for Maximum Intake Manifold Pressure calculation ≥ 0 % AND ≤ 100 % OR Engine Exhaust Gas Recirculation Valve feedback position for Maximum Intake Manifold Pressure calculation} 8. Engine Torque Set point for Maximum Intake Manifold Pressure Value Calculation ≥ 450 N·m {Minimum Time Entry conditions 1, 2, 3, and 4 (mentioned above) has to be satisfied for "Minimum Intake Manifold Pressure" value calculation ≥ 3 seconds

		AND Minimum Time Entry conditions 5, 6, 7, and 8 (mentioned above) has to be satisfied for "Maximum Intake Manifold Pressure" value calculation ≥ 3 seconds AND Intake ambient pressure during Maximum Intake Manifold Pressure calculation MINUS Intake ambient pressure during minimum Intake Manifold Pressure calculation} ≤ 0.199 kPa SPN/FMI 102/3, 102/4, 108/3, and 108/4 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 102 FMI 10 - Boost slow response fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Intake Manifold #1 Pressure (Boost) Slow response monitor	Integral of Absolute Value of Engine Intake Manifold # 1 Pressure deviation from set point > 8200 * 0.1 * hPa * seconds	Key ON Particulate Filter Regeneration NOT Active SCR Warm-up NOT Active Barometric Pressure ≥ 73.5 kPa AND ≤ 103 kPa Ambient Air Temperature ≥ -7 °C AND ≤ 60 °C Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Engine is NOT coasting (i.e. Throttle Cut OFF mode) Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Time after engine start ≥ 30 seconds Engine Speed > 750 RPM Engine Speed gradient > 79.98 RPM/second Torque Set point > 700 N·m Torque Set point gradient ≥ -10 N·m/second Monitor enablement based on Engine Coolant Temperature (Table A008) Monitor enablement based on Barometric Pressure (Table A009) Monitor enablement based on Engine Air Intake temperature (Table A010) Engine Intake Manifold Pressure # 1 rate of change > Value described in Speed/Torque table (Table A012) * Engine coolant modifier (Table A013) * Altitude modifier (Table A014)

		SPN/FMI's 132/3, 132/4, 132/0, 132/1, 172/3,4, 172/2, 1173/2, 2630/2, 102/3,4, 102/7, 105/3,4, 105/2, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, and 102/18 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 102 FMI 16 - Overboost

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Intake Manifold Pressure too High	[Engine Intake Manifold Pressure Value > Threshold described in Speed/Torque table (Table A016) * Engine coolant modifier (Table A017) * Altitude modifier (Table A018) * Intake air temperature modifier (Table A019) * Intake manifold temperature modifier (Table A020) AND maximum value of rate based threshold counter {Counter rate is dependent on Intake Manifold Pressure deviation from Threshold}] > 64000 hPa * seconds	Particulate Filter Regeneration NOT Active Barometric Pressure ≥ 73.5 kPa AND ≤ 103 kPa SCR Warm-up NOT Active Ambient Air Temperature ≥ -7 °C AND ≤ 60 °C Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Engine is NOT coasting (i.e. Throttle Cut OFF mode) Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Engine Ignition Key is in "ON" position (Key ON) Time after engine start ≥ 30 seconds Engine Torque command ≤ 1800 N·m Speed/Torque based enable table (Table A015) SPN/FMI's 132/3, 132/4, 132/0, 132/1, 172/3,4, 172/2, 1173/2, 2630/2, 102/3,4, 102/7, 105/3,4, 105/2, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 1173/16, 651/14, 652/14, 653/14, 654/14, 655/14, 656/14, 4257/16, 4257/18, 164/16, and 164/18 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 102 FMI 18 - Underboost

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Intake Manifold Pressure too Low {Underboost Monitor}	[Engine Intake Manifold Pressure < Threshold defined in Speed/Torque table (Table A021) * Engine coolant modifier (Table A022) * Altitude modifier (Table A023) * Intake air temperature modifier (Table A024) * Intake manifold temperature modifier (Table A025) AND {Moving Mean average of measured Engine Intake Air Mass Flow rate MINUS Modeled value of Engine Intake Air Mass Flow rate > Threshold defined by Speed/Torque based table [Table A108] * Ambient pressure modifier table [Table A109] * Engine coolant temperature modifier table [Table A110] for time}] ≥ 25 seconds	Key ON Particulate Filter Regeneration NOT Active Barometric Pressure ≥ 73.5 kPa AND ≤ 103 kPa Ambient Air Temperature ≥ -7 C AND ≤ 60 C SCR Warm-up NOT Active Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Engine is NOT coasting (i.e. Throttle Cut OFF mode) Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Time after engine start ≥ 30 seconds EGR Valve feedback position ≤ 100 % Speed/Torque based enable table (Table A026) Pre-debounce counter after Engine Intake Manifold Pressure value is below modeled threshold value as defined in "Malfunction Criteria/Threshold Value" section > Speed/Torque table (Table A097) Absolute Engine Intake Manifold # 1 Pressure Gradient ≤ 5434 kPa/second Engine Speed Gradient ≤ 50 RPM/second Engine Torque Gradient ≤ 20 N·m/second SPN/FMI's 132/3, 132/4, 132/0, 132/1, 172/3,4, 172/2, 1173/2, 2630/2, 102/3,4, 102/7, 105/3,4, 105/2, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 1173/16, 102/10, 651/14, 652/14, 653/14, 654/14,

		655/14, 656/14, 4257/16, 4257/18, 164/16, and 164/18 are NOT Active

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

IMT Sensor (Intake Manifold Temperature)

Overview of IMT Sensor Group

SPN	FMI	Condition
105	2	IMT signal Erratic, Intermittent, or Incorrect (page 1350)
105	3	IMT signal Out of Range HIGH (page 1355)
105	4	IMT signal Out of Range LOW (page 1361)

Overview

Intake Manifold Temperature (IMT) sensor provides feedback signal to Engine Control Module (ECM) indicating manifold air temperature. ECM controls Exhaust Gas Recirculation (EGR) system based on air temperature in intake manifold. This aids in cold engine starting and warm-ups, and also reduces exhaust emissions.

SPN 105 FMI 2 - IMT signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Manifold Temperature (IMT) does not agree with other sensors	Temperature difference between IMT and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, TC2CIT, CACOT, IAT, and EOT are all within 59°F (15°C) of each other

Fault Overview

ECM Compares Intake Manifold Temperature (IMT) sensor to Intake Air Temperature (IAT), Turbocharger 2 Compressor Intake Temperature (TC2CIT), Charge Air Cooler Outlet Temperature (CACOT), Engine Coolant Temperature 1 (ECT1), and Engine Oil Temperature (EOT) sensors at initial Key-On after an 8-hour cold soak.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 105 FMI 3 and 4 (IMT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (After Cold Soak)

Possible Causes

- High resistance in IMT circuit
- High resistance in SIG GND circuit
- Failed IMT sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1350). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 105 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 105 FMI 2. Is EST DTC list SPN 105 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Intake Manifold Temperature (IMT) connector.	Decision
A. Key OFF. B. Disconnect IMT connector. C. Check IMT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IMT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 105 FMI 2.

Pin-Point Tests (SPN 105 FMI 2)

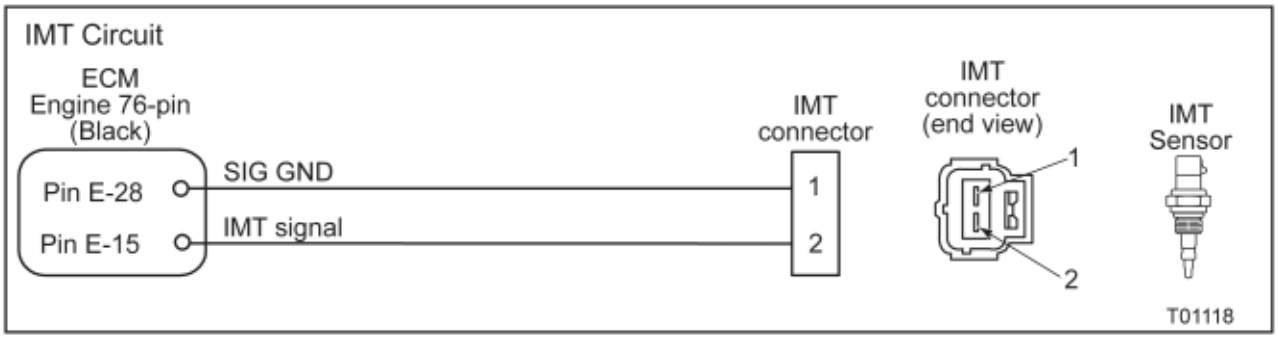
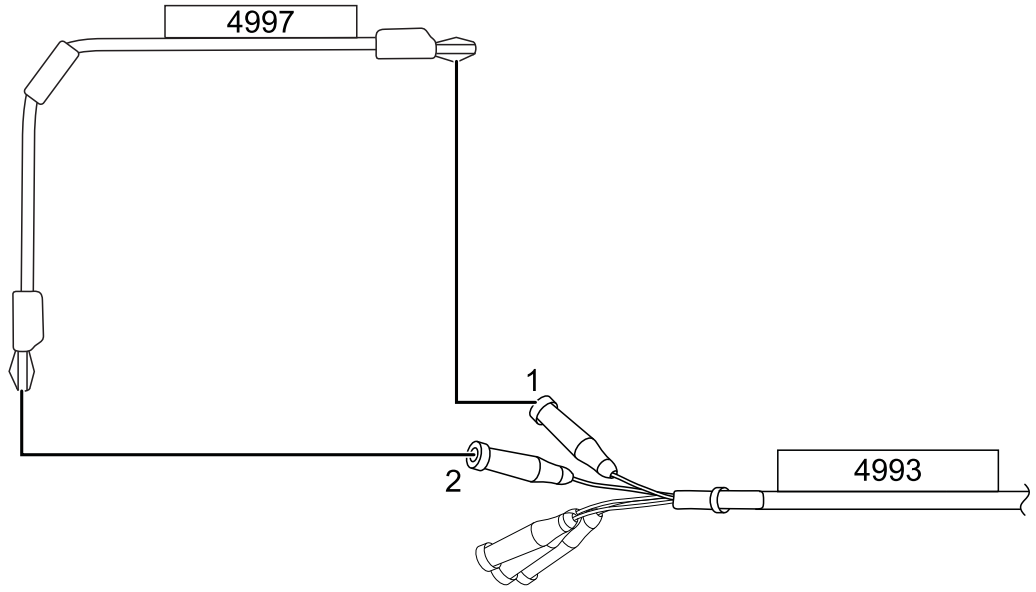


Figure 484 Intake Manifold Temperature (IMT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4993
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334581

Figure 485 Test 1 Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Intake Manifold Temperature (IMT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave IMT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor intake manifold temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace IMT sensor. After repairs are complete, retest for SPN 105 FMI 2.
	No: Go to Test 2.

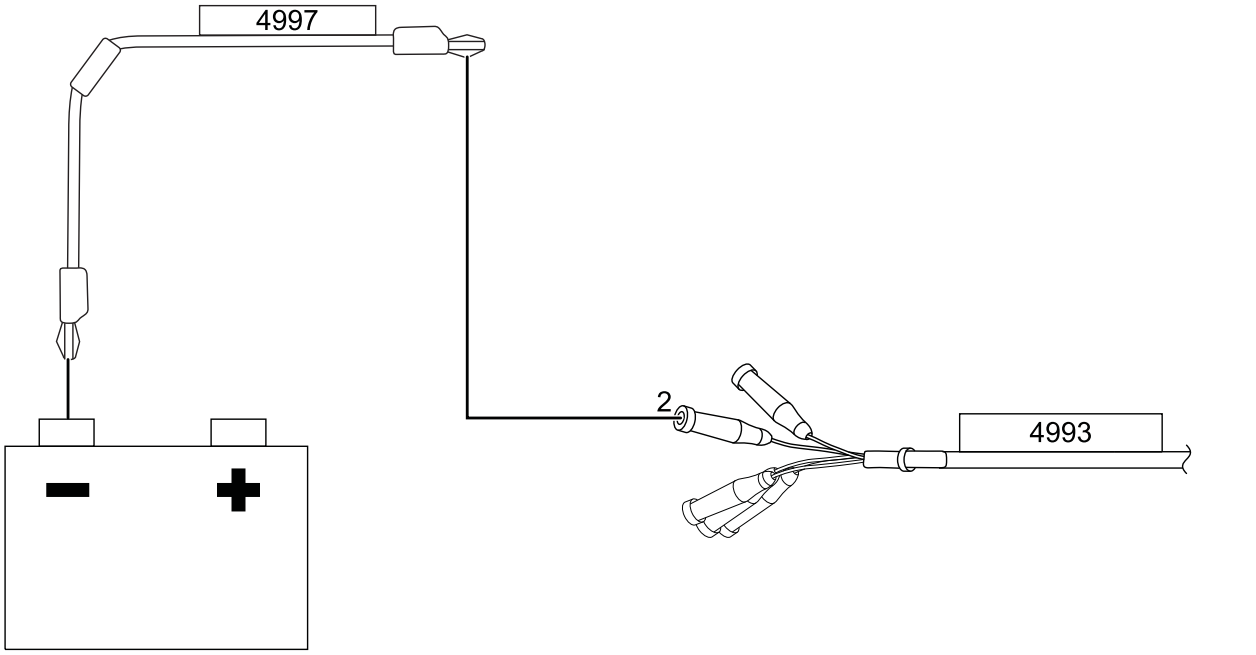


Figure 486 Test 2 IMT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Intake Manifold Temperature (IMT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave IMT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor intake manifold temperature.	302 ± 10°F (150 ± -12.2°C)
Decision	
Is temperature 302 ± 10°F (150 ± -12.2°C)?	Yes: Replace SIG GND circuit between IMT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 105 FMI 2.
	No: Replace SIG circuit between IMT pin-2 and ECM pin E-15. After repairs are complete, retest for SPN 105 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 105 FMI 2 fault code diagnostics.

SPN 105 FMI 3 - IMT signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Intake Manifold Temperature (IMT) signal reading is greater than expected	IMT sensor reading > 4.80 volts	Key ON

Fault Overview

Fault Code sets when Engine Control Module (ECM) detects that Intake Manifold Temperature (IMT) signal is greater than 4.80 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IMT circuit Open
- IMT circuit short to PWR
- SIG GND circuit Open
- Failed IMT sensor

Step 1	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 105 FMI 3. Does EST DTC list show SPN 105 FMI 3 as active?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Intake Manifold Temperature (IMT) sensor.	Decision
A. Key OFF. B. Disconnect IMT sensor connector. C. Check IMT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IMT sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, and / or terminal damage. After repairs are complete, retest for SPN 105 FMI 3.

Pin-Point Tests (SPN 105 FMI 3)

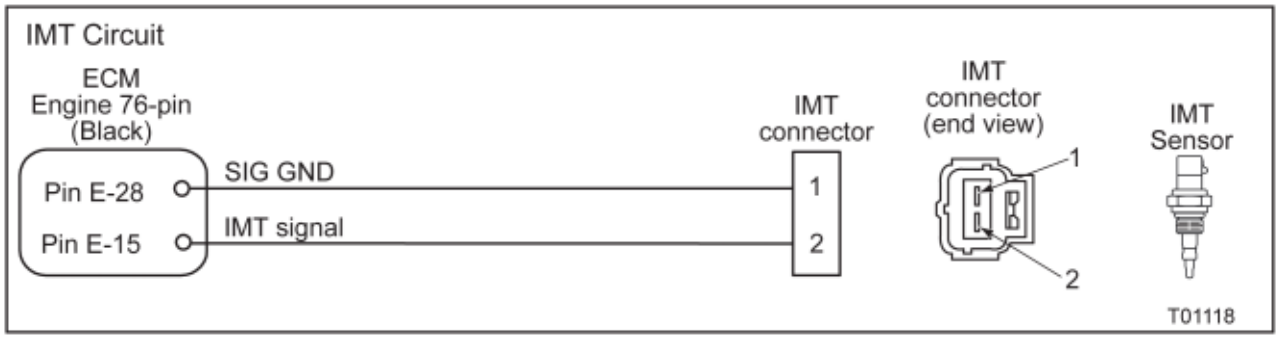


Figure 487 Intake Manifold Temperature (IMT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4993
- Breakout Harness 3-Banana Plug ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

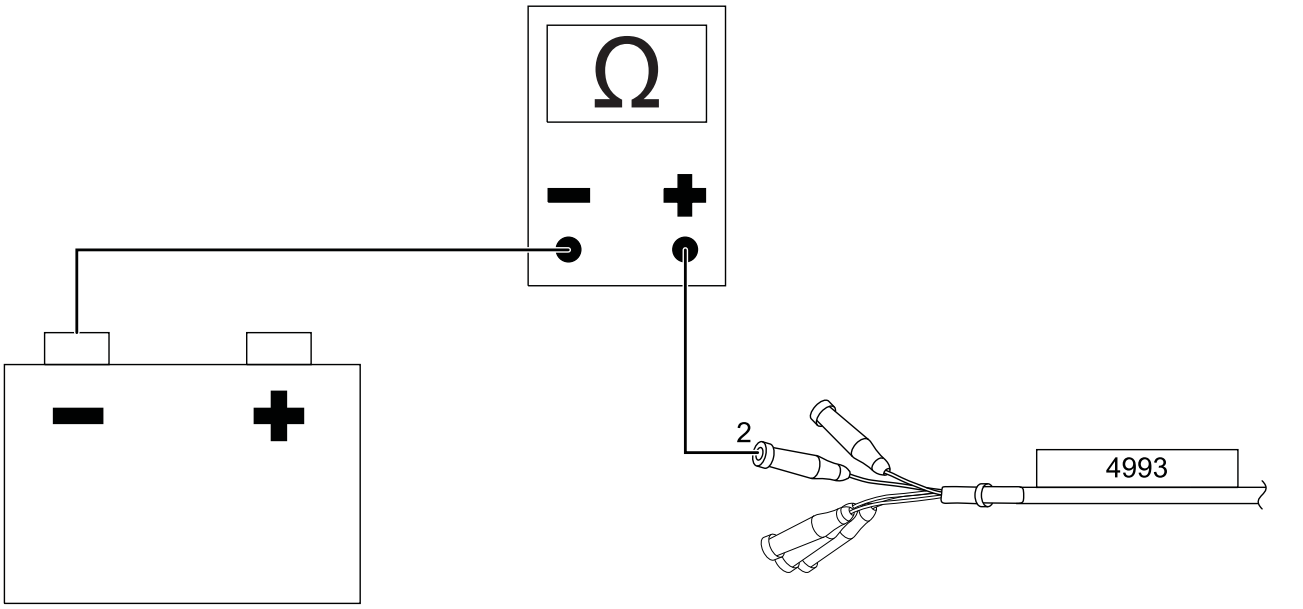
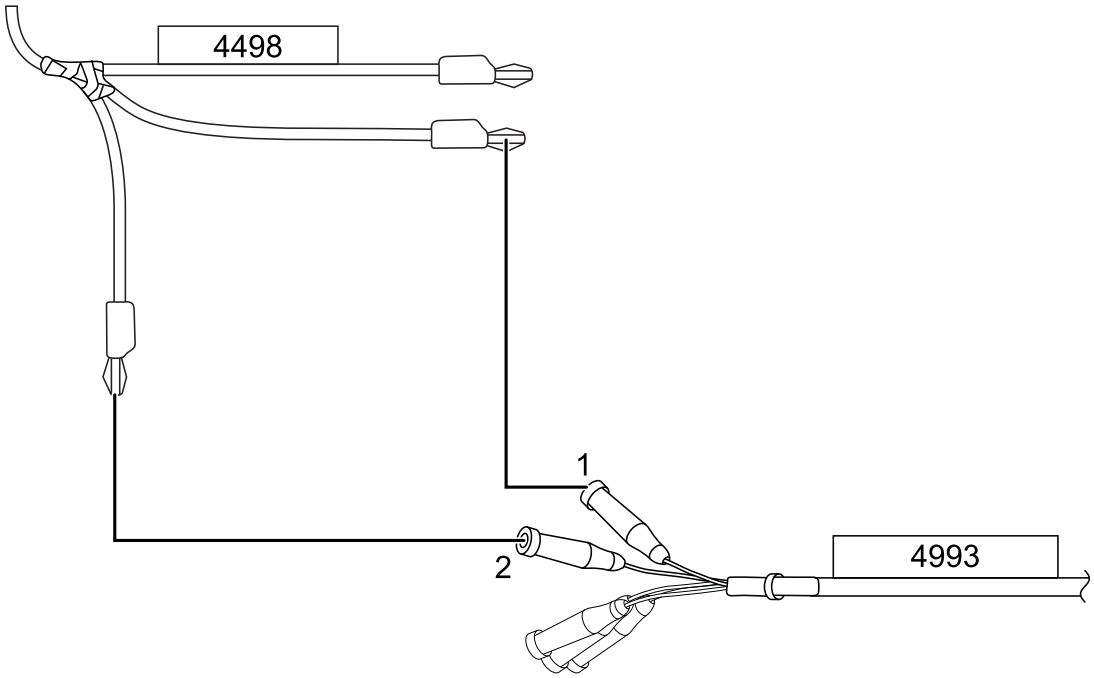


Figure 488 Test 1 Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave Intake Manifold Temperature (IMT) sensor disconnected. C. Key ON.

Test 1	Specification
Using DMM, measure voltage between Breakout Harness ZTSE4993 pin-2 and known good GND.	Greater than 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to PWR between IMT pin-2 and ECM pin E-15. After repairs are complete, retest for SPN 105 FMI 3.
	No: Go to Test 2.



0000301703

Figure 489 Test 2 IMT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness and leave IMT sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-2 of Breakout Harness ZTSE4993 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software

Test 2	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 105 FMI 4 sets
Decision	
Does SPN 105 FMI 4 set after DTC list is cleared?	Yes: Replace IMT sensor. After repairs are complete, retest for SPN 105 FMI 3.
	No: Go to Test 3.

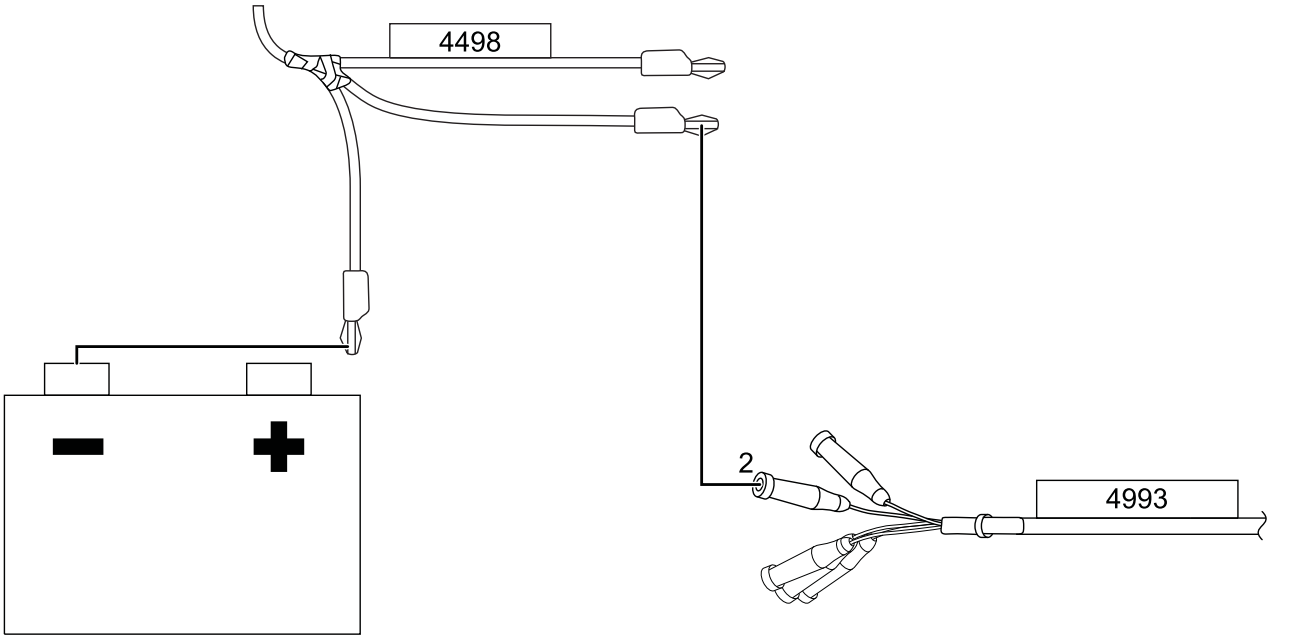


Figure 490 Test 3 Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness and leave IMT sensor disconnected. C. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4993 pin-2 circuit to known good GND. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 105 FMI 4 sets.
Decision	
Does SPN 105 FMI 4 set after DTC list is cleared?	Yes: Repair Open between IMT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 105 FMI 3.
	No: Repair Open between IMT pin-2 and ECM pin E-15. After repairs are complete, retest for SPN 105 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 105 FMI 3 fault code diagnostics.

SPN 105 FMI 4 - IMT signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Manifold Temperature (IMT) signal voltage reading is less than expected.	IMT signal voltage < 0.16 volts	Key ON

Fault Overview

Fault Code sets when Engine Control Module (ECM) detects Intake Manifold Temperature (IMT) signal is less than 0.16 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IMT signal circuit short to GND
- Failed IMT

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 105 FMI 4. Is EST DTC list SPN 105 FMI 4 active or pending?		Yes: Go to Step 2. No. Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Intake Manifold Temperature (IMT) sensor.	Decision
A. Key OFF. B. Disconnect IMT sensor connector. C. Check IMT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, broken pins; or broken connector housing. Are IMT sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, and terminal damage. After repairs are complete, retest for SPN 105 FMI 4.

Pin-Point Tests (SPN 105 FMI 4)

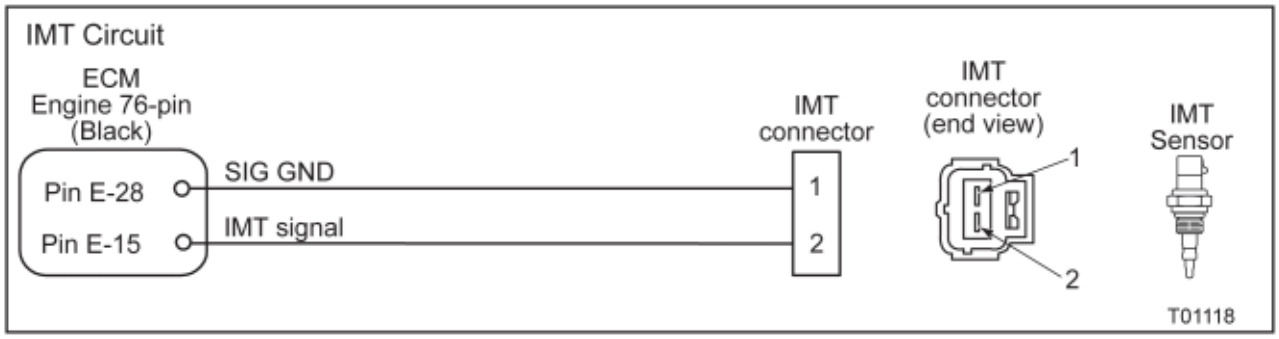


Figure 491 Intake Manifold Temperature (IMT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Intake Manifold Temperature (IMT) sensor and leave sensor disconnected. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 105 FMI 3 sets in DTC list
Decision	
Does SPN 105 FMI 3 set after DTC list is cleared?	Yes: Replace IMT sensor. After repairs are complete, retest for SPN 105 FMI 4.
	No: Repair short to GND between IMT connector pin-2 and Engine Control Module (ECM) pin E1-15. After repairs are complete, retest for SPN 105 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3509 FMI 3 fault code diagnostics.

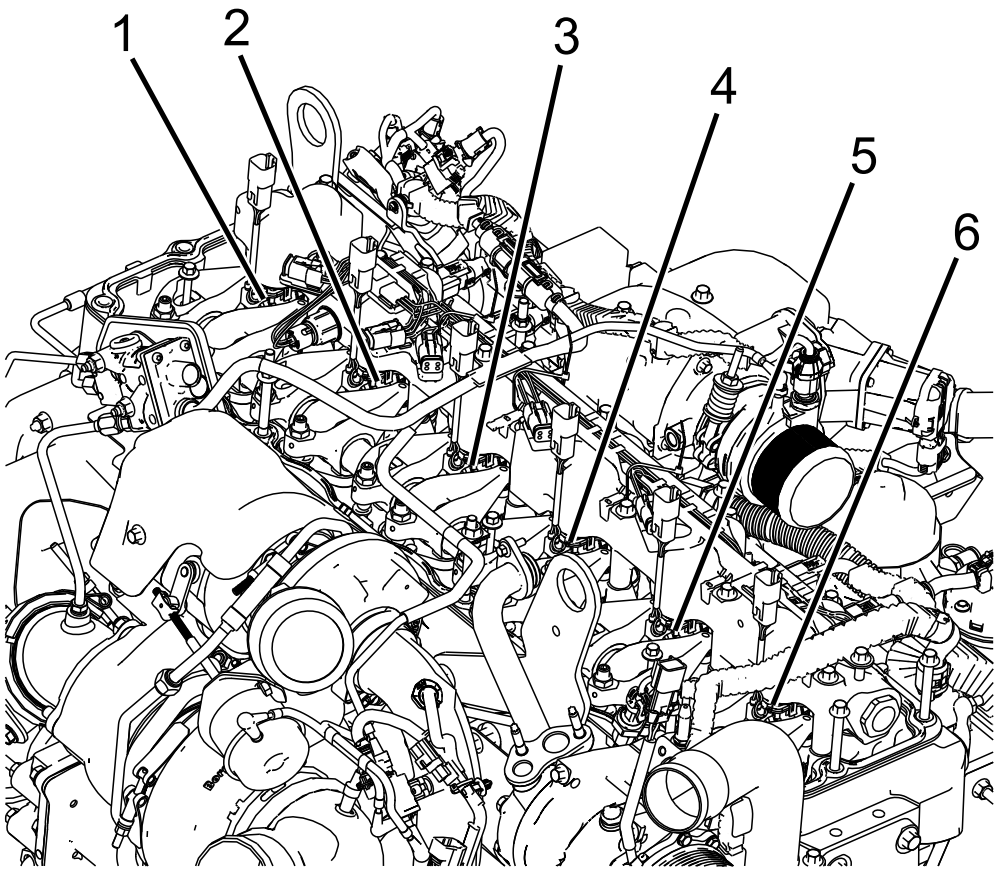
INJ (Injector) Circuits

Overview of INJ Sensor Group

SPN	FMI	Condition
651	4	Injector 1 open coil - short circuit (page 1367)
652	4	Injector 2 open coil - short circuit (page 1376)
653	4	Injector 3 open coil - short circuit (page 1385)
654	4	Injector 4 open coil - short circuit (page 1394)
655	4	Injector 5 open coil - short circuit (page 1403)
656	4	Injector 6 open coil - short circuit (page 1412)
651 - 656	5	Injector 1 (through 6) open coil - open circuit
651 - 656	7	Injector 1 (through 6) Spool Motion Compensation Max Authority Reached (page 1465)
651	14	Injector 1 Fuel quantity/timing error (page 1467)
652	14	Injector 2 Fuel quantity/timing error (page 1484)
653	14	Injector 3 Fuel quantity/timing error (page 1501)
654	14	Injector 4 Fuel quantity/timing error (page 1517)
655	14	Injector 5 Fuel quantity/timing error (page 1533)
656	14	Injector 6 Fuel quantity/timing error (page 1549)
2797	6	Injector Control Group 1 - short circuit (INJ 1, 2, 3) (page 1565)
2798	6	Injector Control Group 2 - short circuit (INJ 4, 5, 6) (page 1611)
3055	2	ICP/IPR Adaptation In-Range Fault (page 1657)
3659	4	Injector 1 close coil – short circuit (page 1661)
3660	4	Injector 2 close coil – short circuit (page 1670)
3661	4	Injector 3 close coil – short circuit (page 1679)
3662	4	Injector 4 close coil – short circuit (page 1688)
3663	4	Injector 5 close coil – short circuit (page 1697)
3664	4	Injector 6 close coil – short circuit (page 1706)
3659	5	Injector 1 close coil – open circuit (page 1715)
3660	5	Injector 2 close coil – open circuit (page 1722)
3661	5	Injector 3 close coil – open circuit (page 1729)
3662	5	Injector 4 close coil – open circuit (page 1736)
3663	5	Injector 5 close coil – open circuit (page 1743)
3664	5	Injector 6 close coil – open circuit (page 1750)
4257	7	Injector Coking Compensation Factor Reached Maximum Authority (page 1757)
4257	16	Multiple Injector High Flow fault (page 1758)
4257	18	Multiple Injector Low Flow fault (page 1763)

Overview

Injectors inject fuel into cylinders. Engine Control Module (ECM) controls timing and amount of fuel being sprayed from each injector. ECM also controls Injection Control Pressure (ICP) system to regulate fuel spray pressure.



0000061615

Figure 492 Injector Locations

1. Injector 6
2. Injector 5
3. Injector 4
4. Injector 3
5. Injector 2
6. Injector 1

SPN 651 FMI 4 - Injector 1 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for open coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when short circuit is detected on injector 1 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 651 FMI 4. Is EST DTC list SPN 651 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

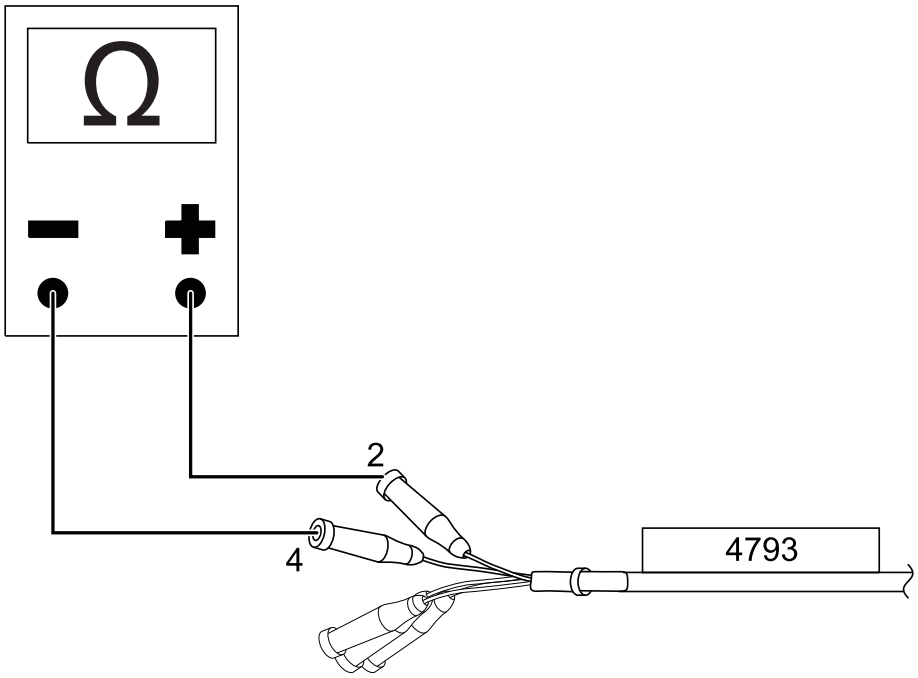
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 651 FMI 4.

Pin-Point Tests (SPN 651 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

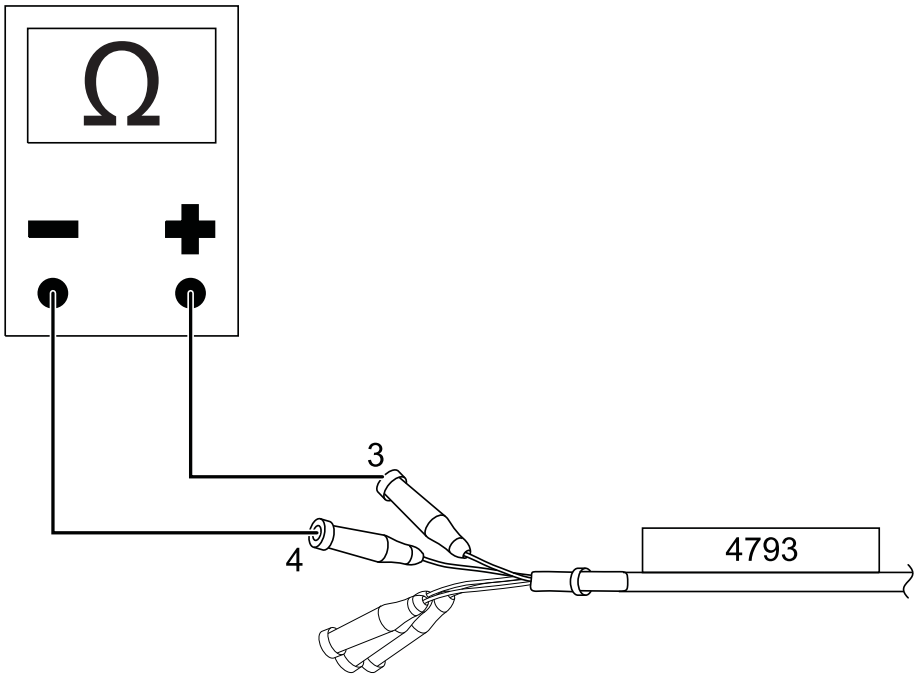


0000326261

Figure 493 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 1 Close and fuel injector 1 Open circuit. After repairs are complete, retest for SPN 651 FMI 4.

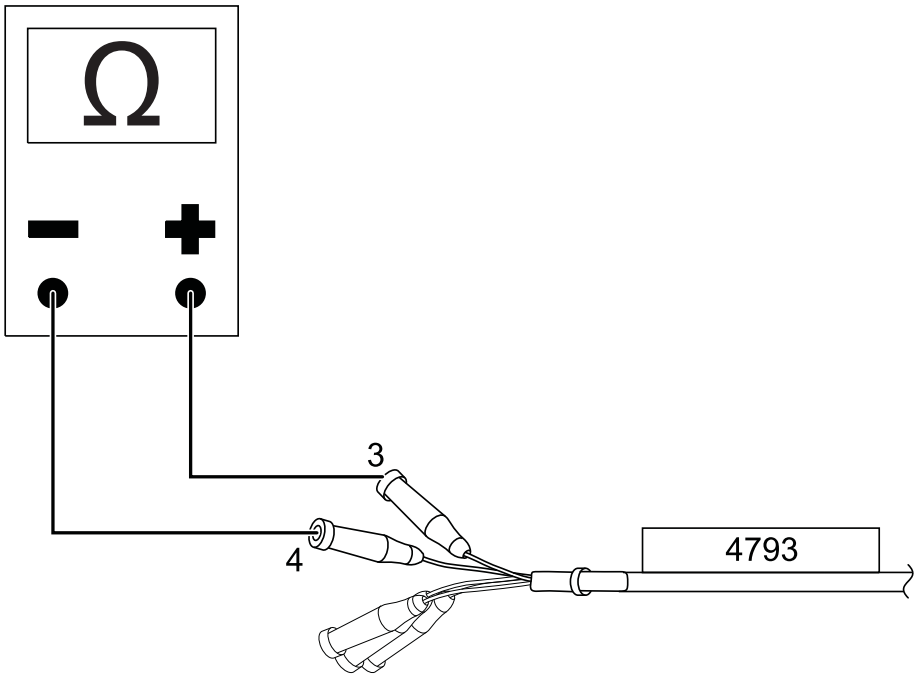


0000326361

Figure 494 Test 2 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326361

Figure 495 Test 3 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 1 Open circuit. After repairs are complete, retest for SPN 651 FMI 4.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 651 FMI 4.

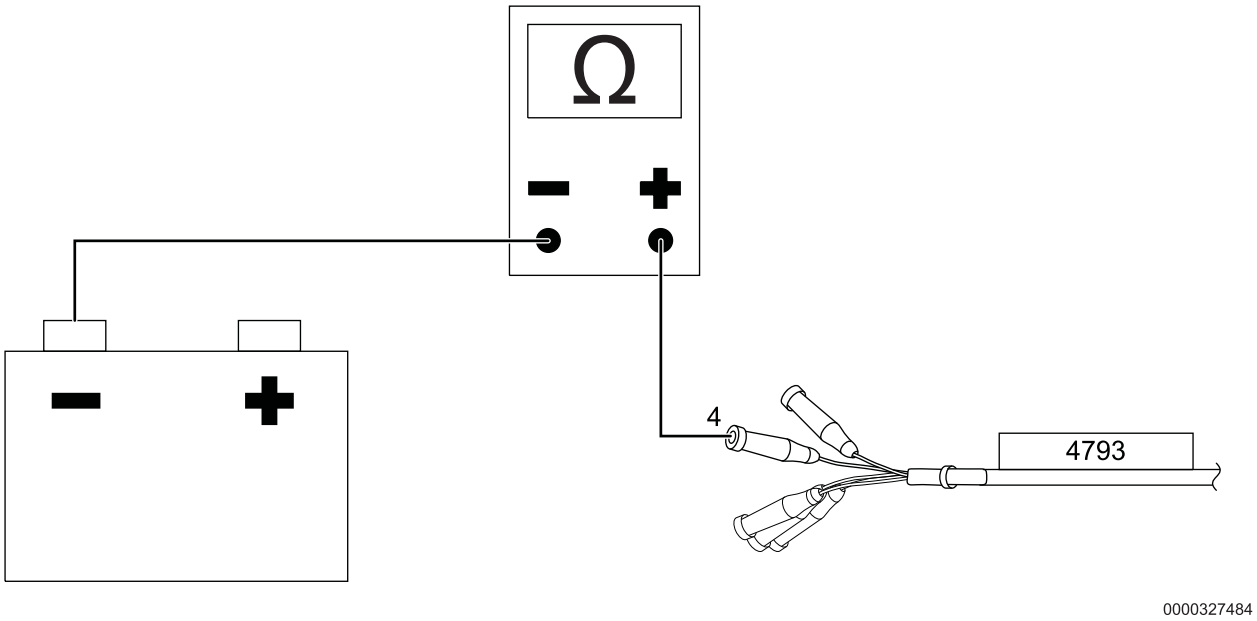


Figure 496 Test 4 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 1 Open H circuit. After repairs are complete, retest for SPN 651 FMI 4.

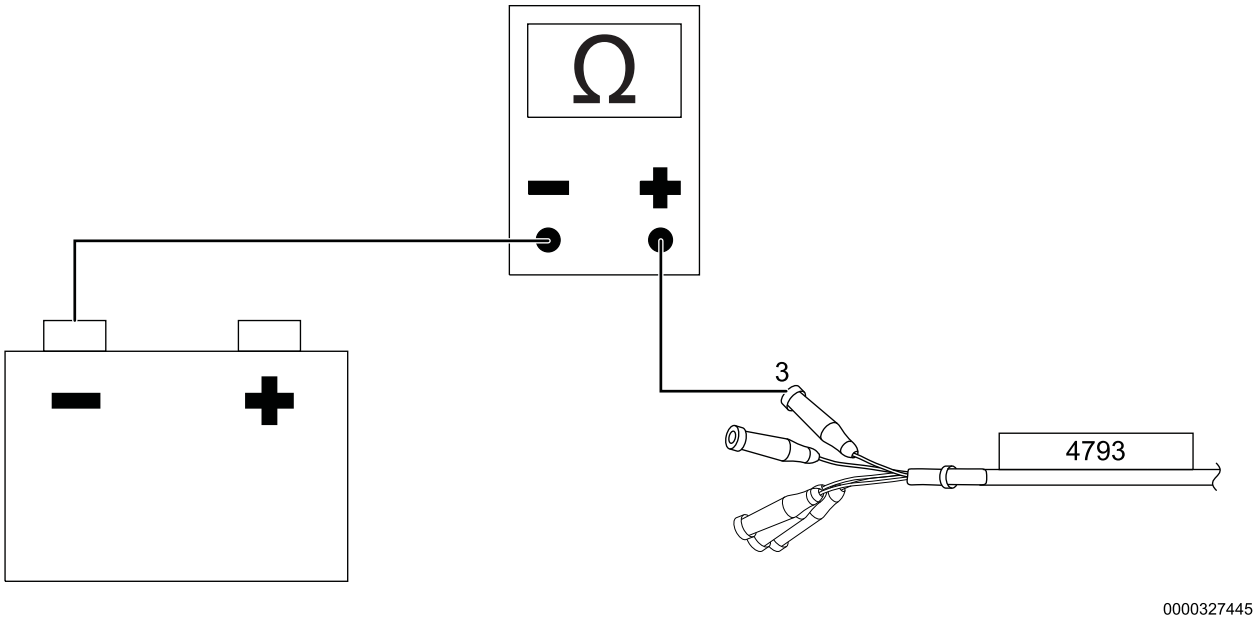


Figure 497 Test 5 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 1 Open L circuit. After repairs are complete, retest for SPN 651 FMI 4.

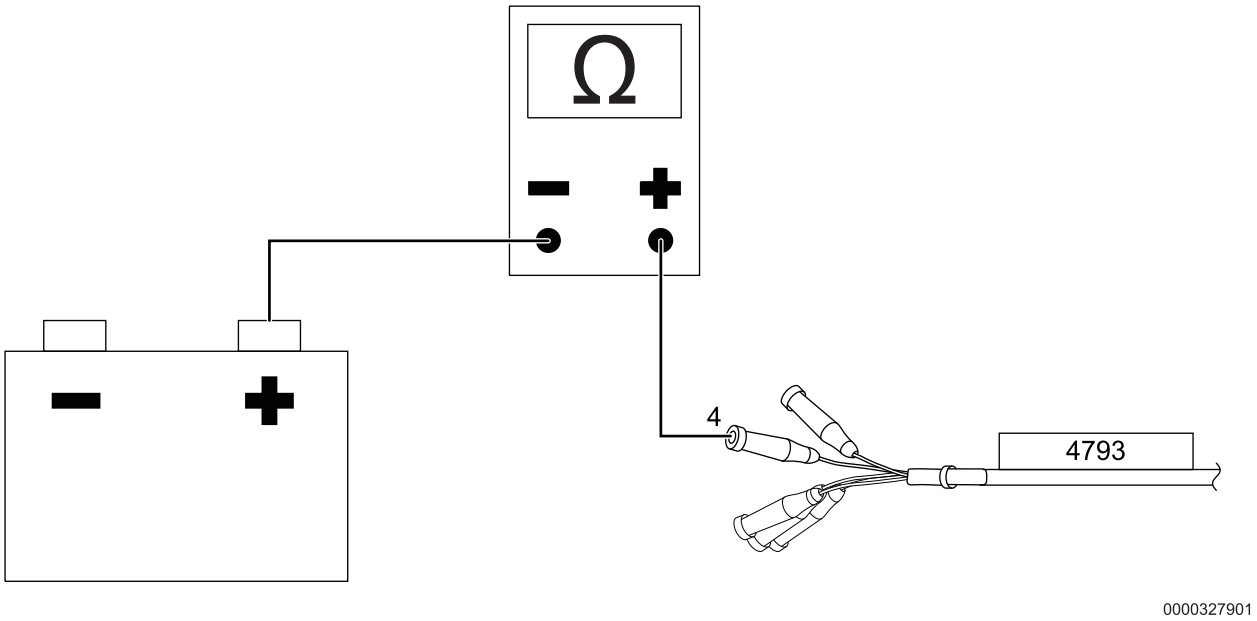


Figure 498 Test 6 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 1 Open L circuit. After repairs are complete, retest for SPN 651 FMI 4.
	No: Repair short to PWR in fuel injector 1 Open H circuit. After repairs are complete, retest for SPN 651 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 651 FMI 4 fault code diagnostics.

SPN 652 FMI 4 - Injector 2 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 2 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 652 FMI 4. Is EST DTC list SPN 652 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

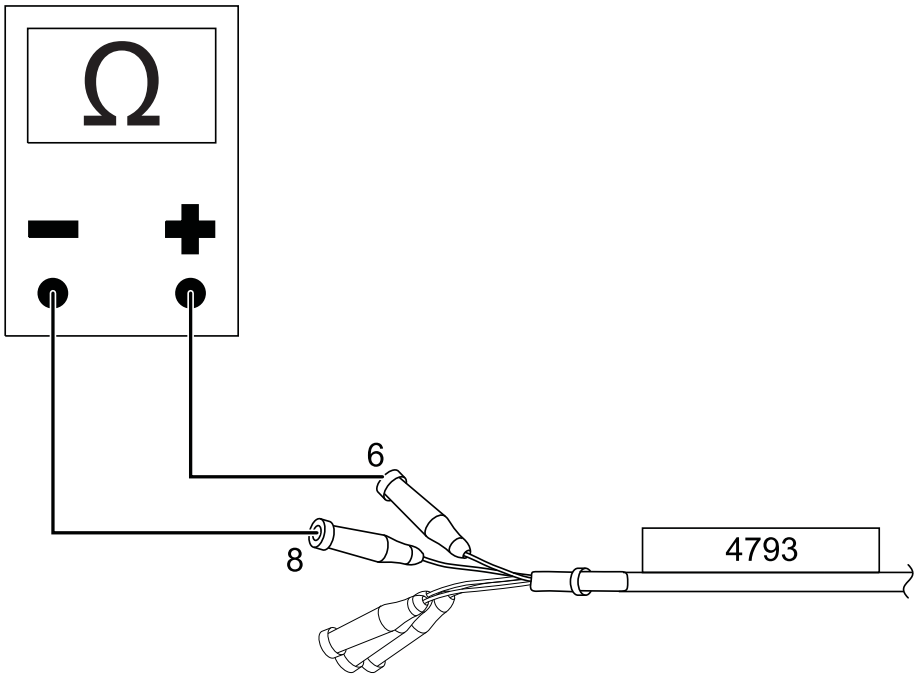
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 652 FMI 4.

Pin-Point Tests (SPN 652 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

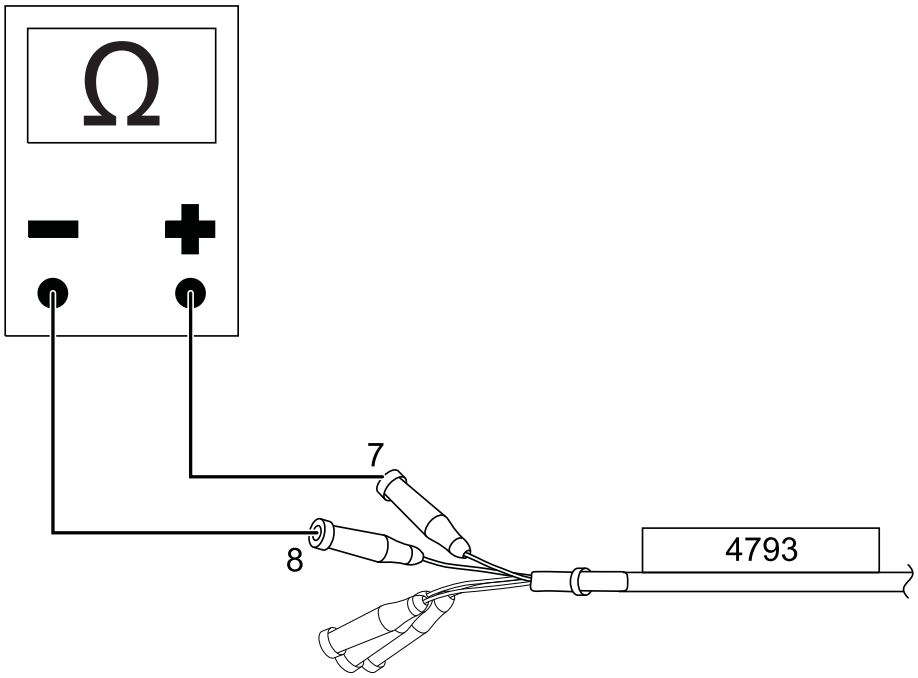


0000326321

Figure 499 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 2 Close and fuel injector 2 Open circuit. After repairs are complete, retest for SPN 652 FMI 4.

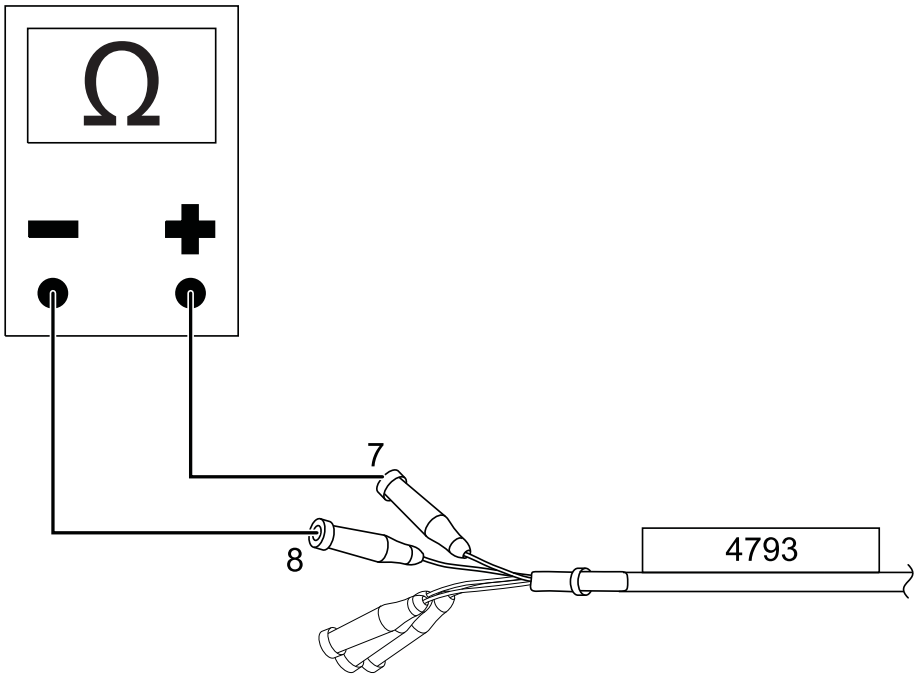


0000326401

Figure 500 Test 2 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326401

Figure 501 Test 3 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 2 Open circuit. After repairs are complete, retest for SPN 652 FMI 4.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 652 FMI 4.

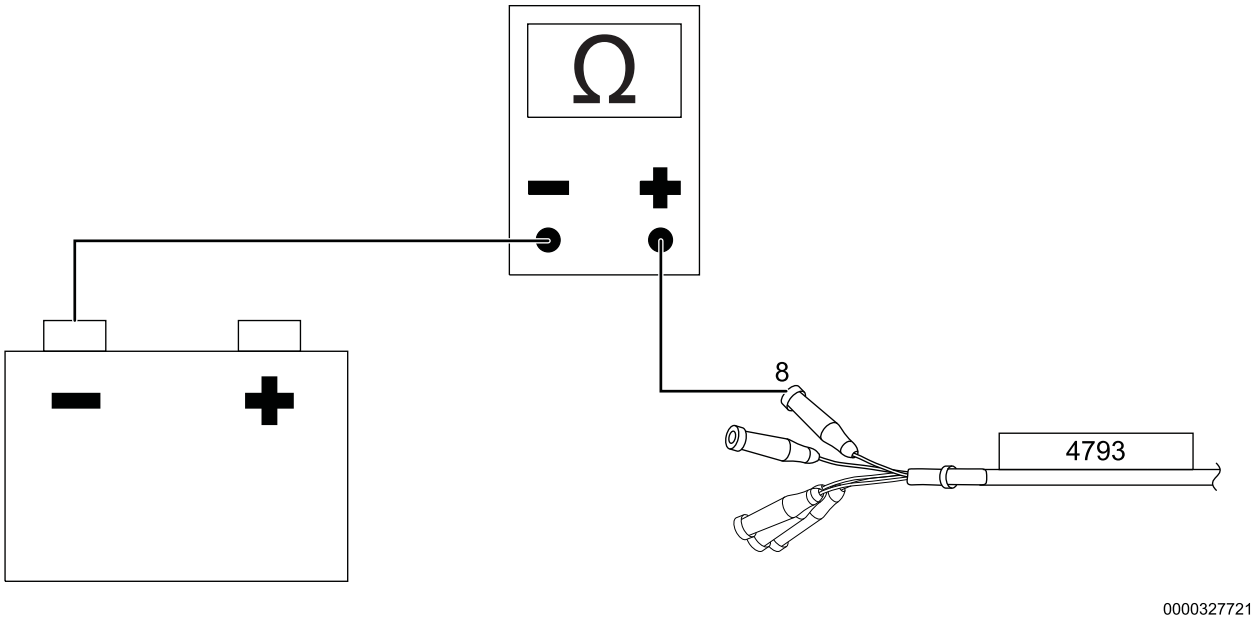


Figure 502 Test 4 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 2 Open H circuit. After repairs are complete, retest for SPN 652 FMI 4.

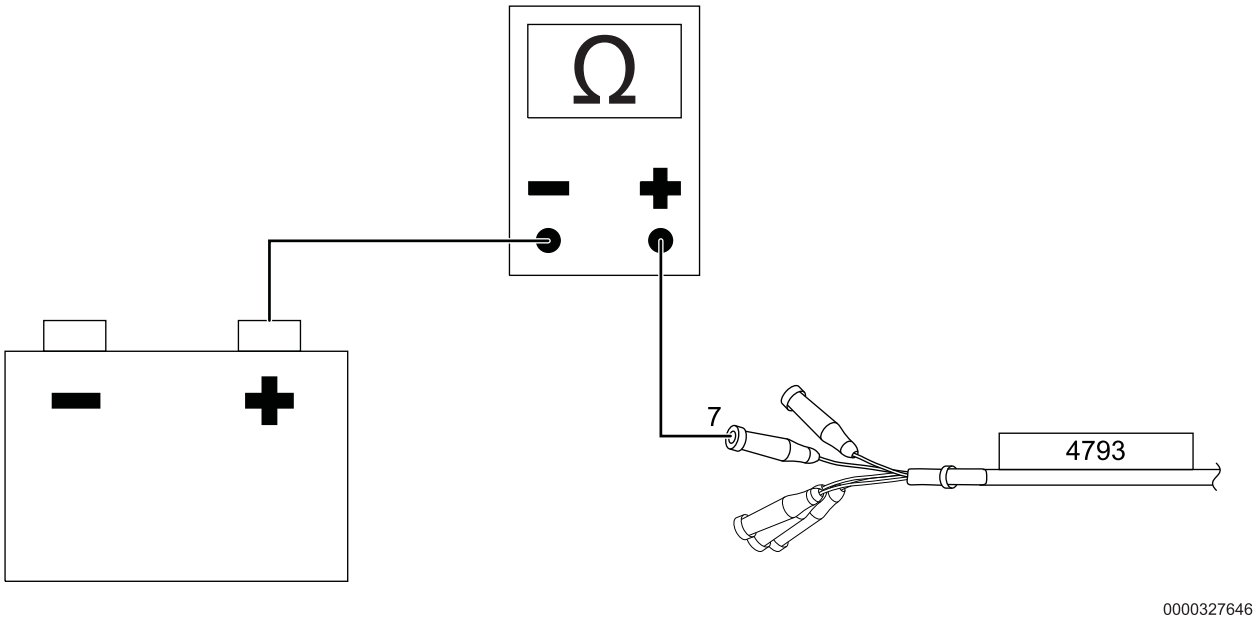


Figure 503 Test 5 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 2 Open L circuit. After repairs are complete, retest for SPN 652 FMI 4.

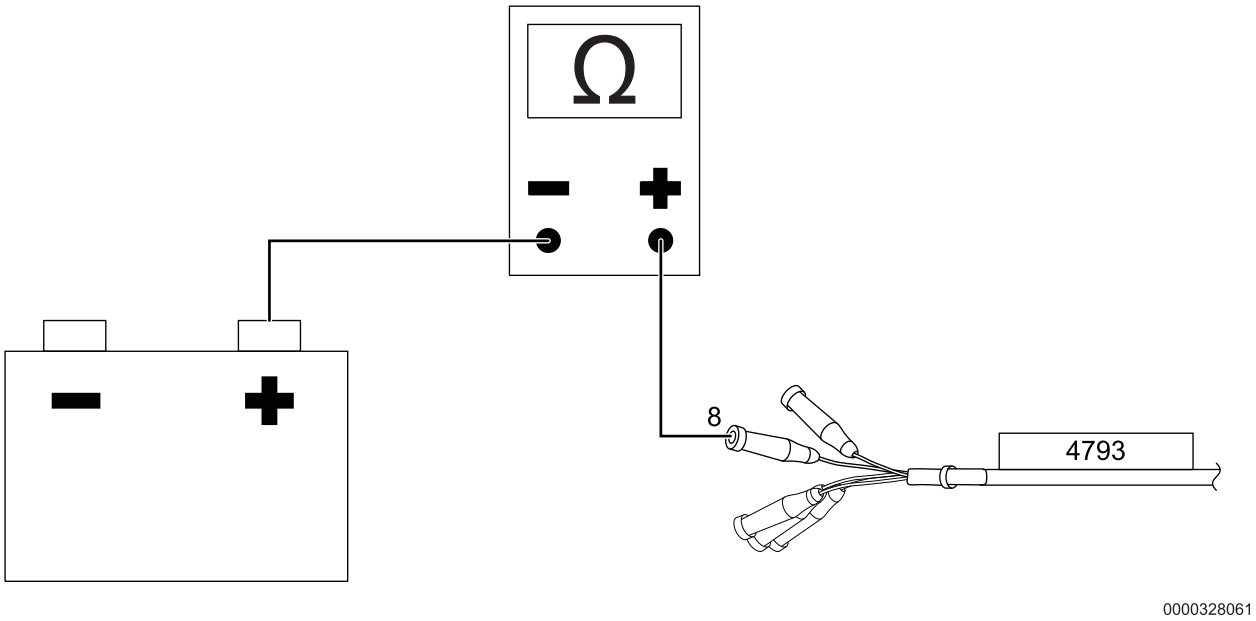


Figure 504 Test 6 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 2 Open L circuit. After repairs are complete, retest for SPN 652 FMI 4.
	No: Repair short to PWR in fuel injector 2 Open H circuit. After repairs are complete, retest for SPN 652 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 652 FMI 4 fault code diagnostics.

SPN 653 FMI 4 - Injector 3 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for open coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when short circuit is detected on injector 3 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 653 FMI 4. Is EST DTC list SPN 653 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

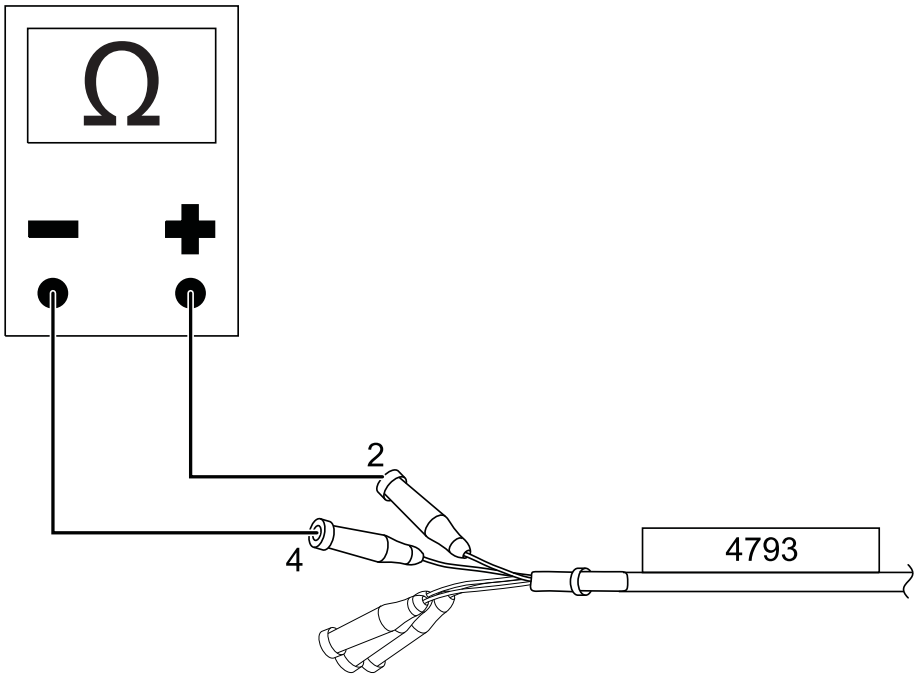
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 653 FMI 4.

Pin-Point Tests (SPN 653 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

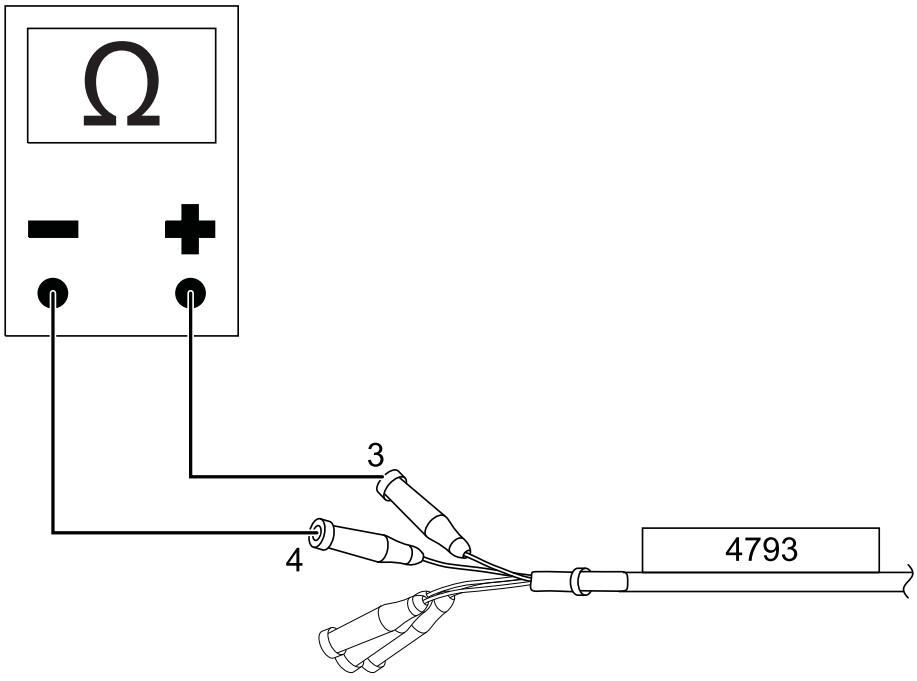


0000326261

Figure 505 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 3 Close and fuel injector 3 Open circuit. After repairs are complete, retest for SPN 653 FMI 4.

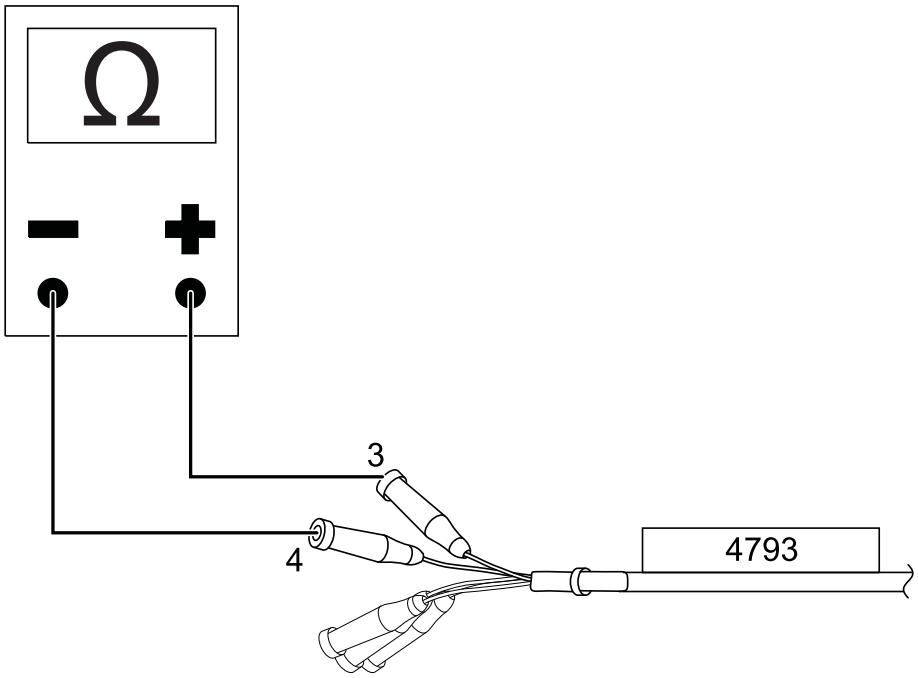


0000326361

Figure 506 Test 2 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326361

Figure 507 Test 3 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 3 Open circuit. After repairs are complete, retest for SPN 653 FMI 4.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 653 FMI 4.

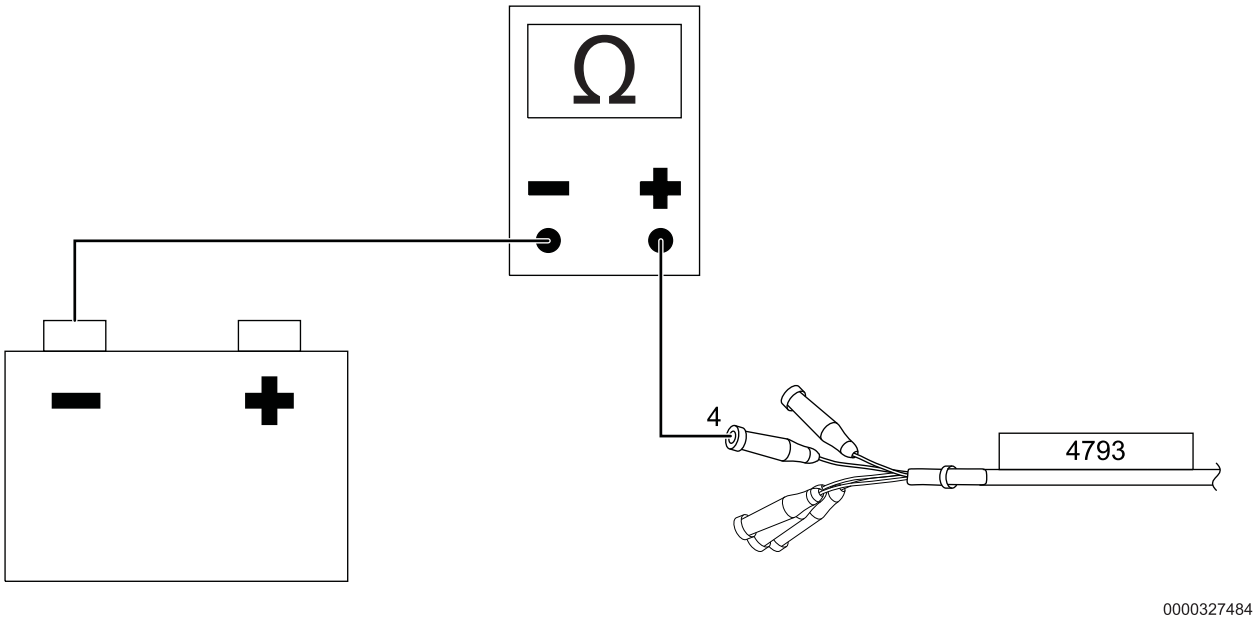


Figure 508 Test 4 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 3 Open H circuit. After repairs are complete, retest for SPN 653 FMI 4.

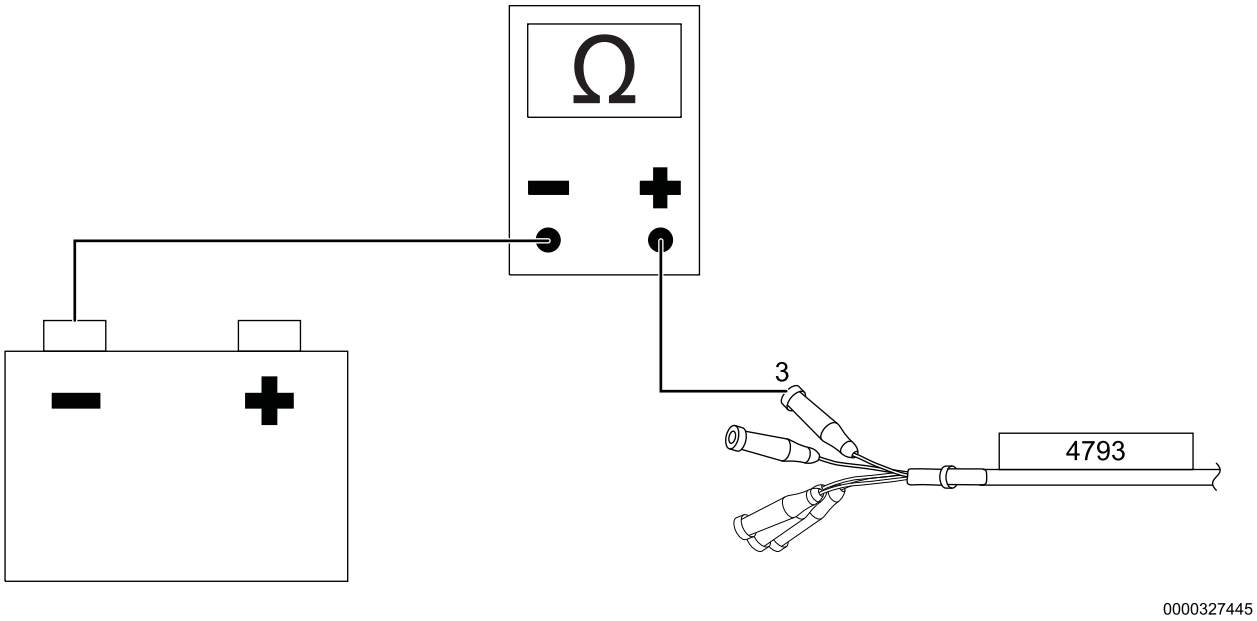


Figure 509 Test 5 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 3 Open L circuit. After repairs are complete, retest for SPN 653 FMI 4.

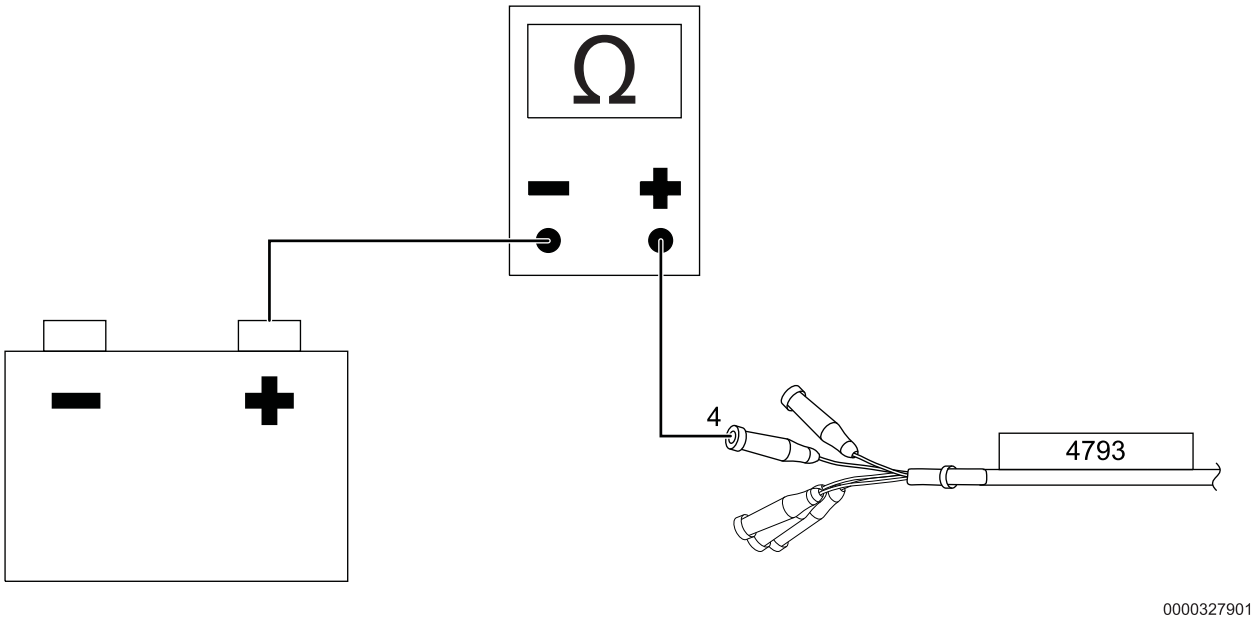


Figure 510 Test 6 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 3 Open L circuit. After repairs are complete, retest for SPN 653 FMI 4.
	No: Repair short to PWR in fuel injector 3 Open H circuit. After repairs are complete, retest for SPN 653 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 653 FMI 4 fault code diagnostics.

SPN 654 FMI 4 - Injector 4 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 4 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 654 FMI 4. Is EST DTC list SPN 654 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

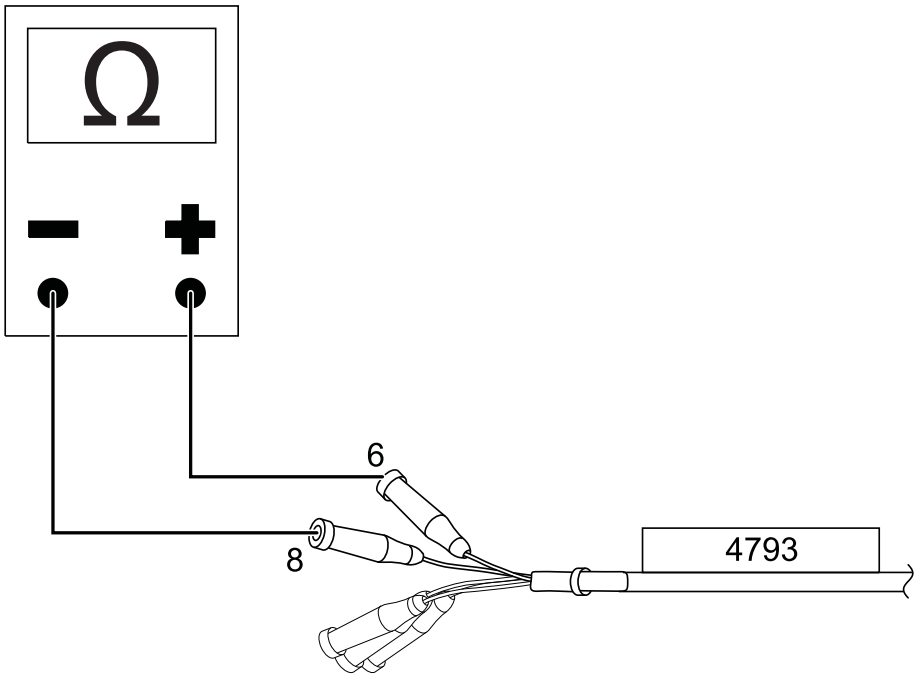
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 654 FMI 4.

Pin-Point Tests (SPN 654 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

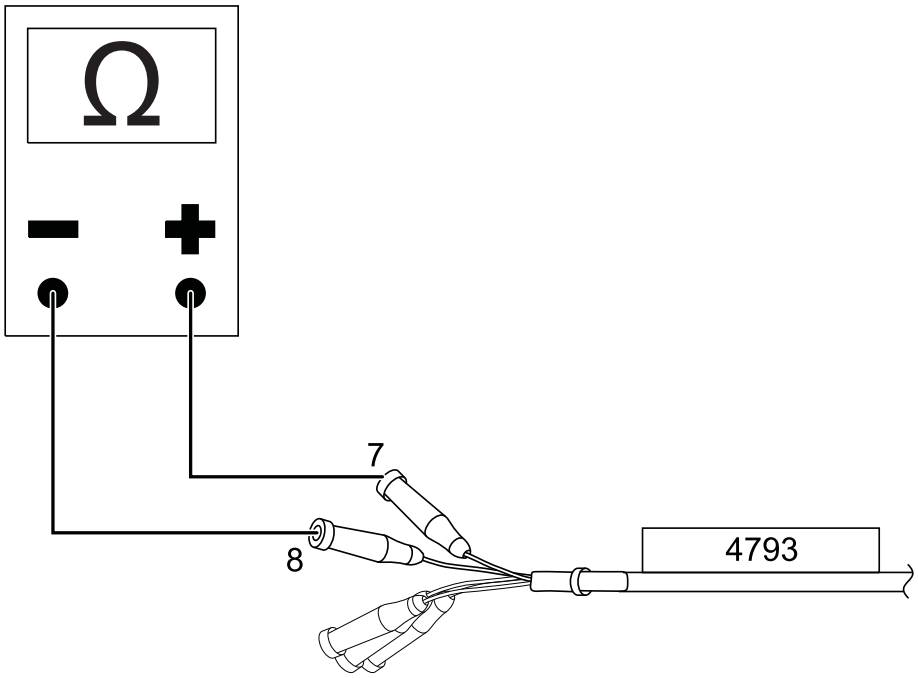


0000326321

Figure 511 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 4 Close and fuel injector 4 Open circuit. After repairs are complete, retest for SPN 654 FMI 4.

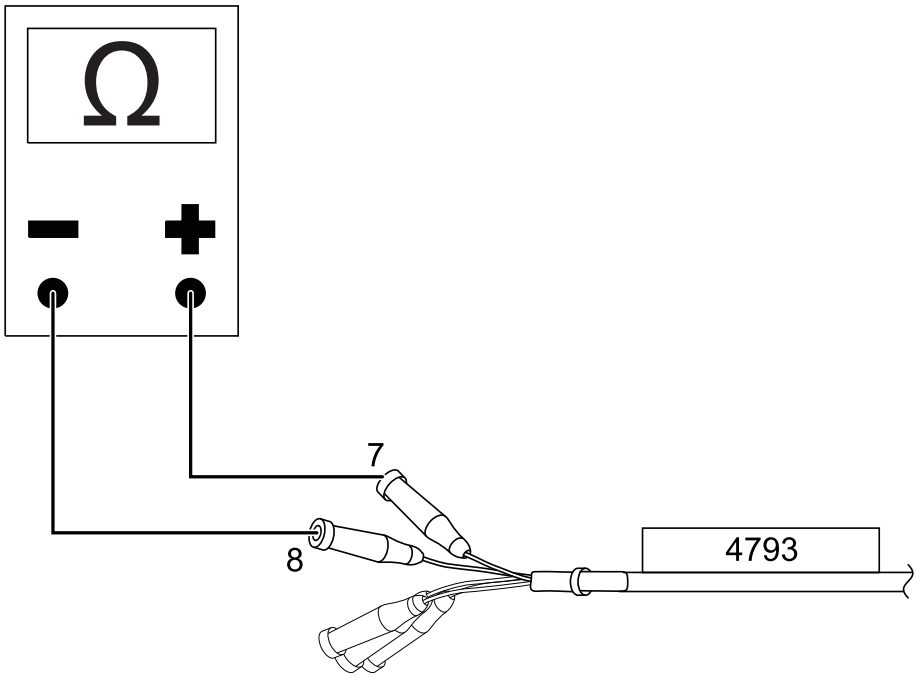


0000326401

Figure 512 Test 2 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326401

Figure 513 Test 3 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 4 Open circuit. After repairs are complete, retest for SPN 654 FMI 4.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 654 FMI 4.

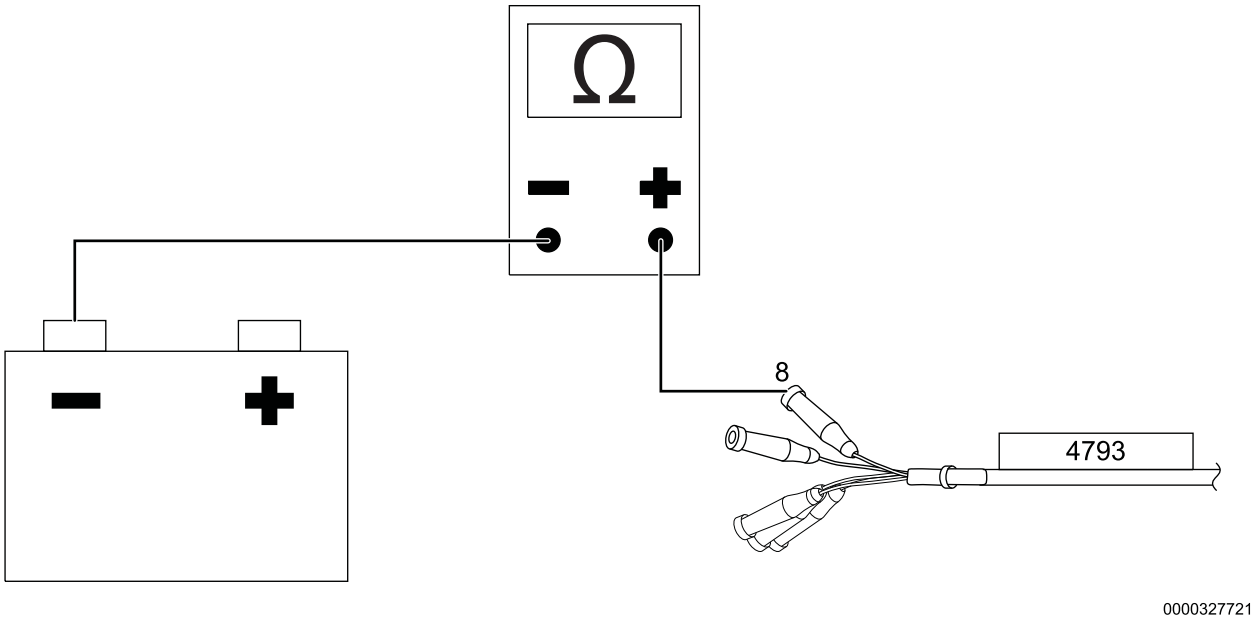


Figure 514 Test 4 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 4 Open H circuit. After repairs are complete, retest for SPN 654 FMI 4.

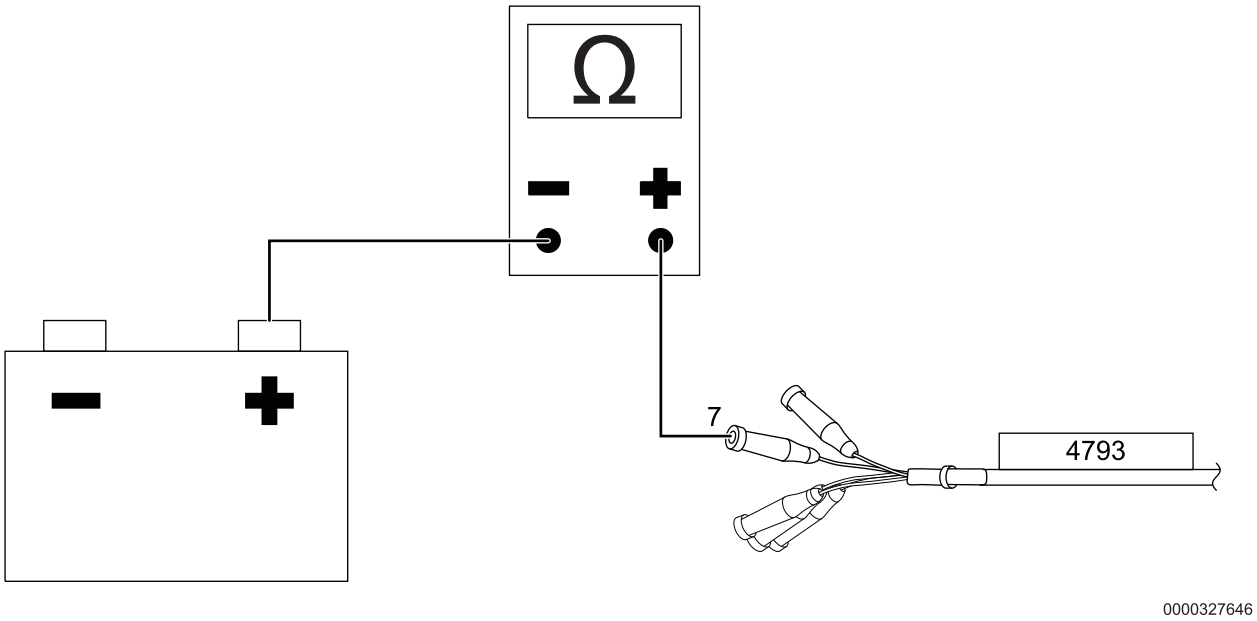


Figure 515 Test 5 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 4 Open L circuit. After repairs are complete, retest for SPN 654 FMI 4.

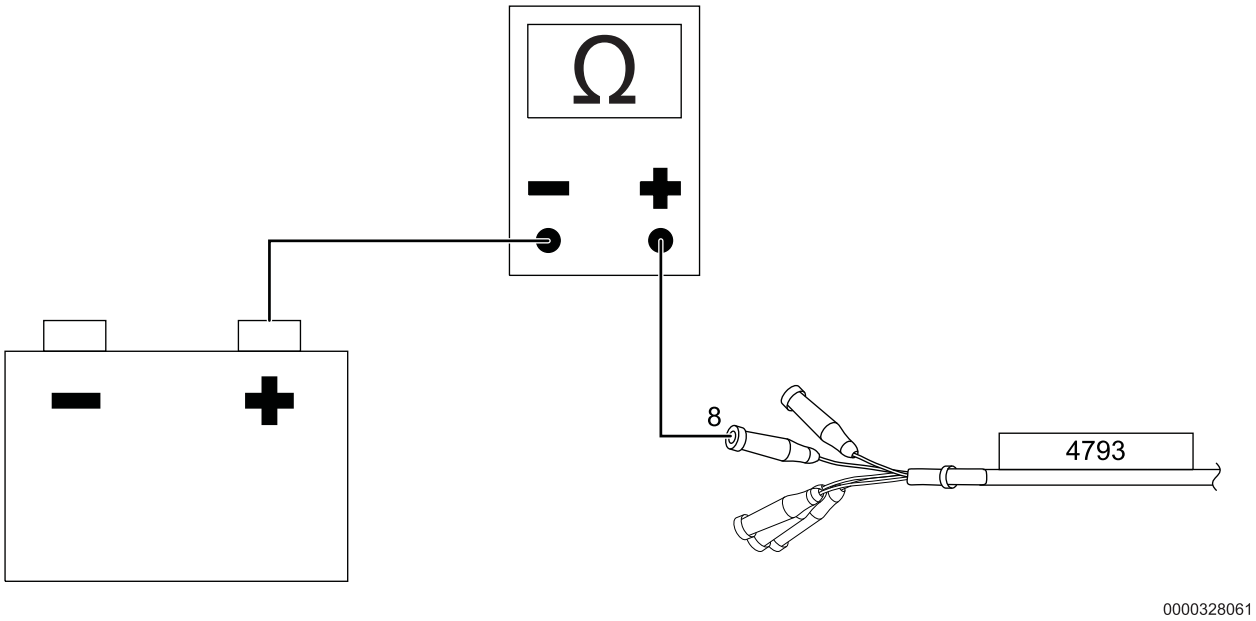


Figure 516 Test 6 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 4 Open L circuit. After repairs are complete, retest for SPN 654 FMI 4.
	No: Repair short to PWR in fuel injector 4 Open H circuit. After repairs are complete, retest for SPN 654 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 654 FMI 4 fault code diagnostics.

SPN 655 FMI 4 - Injector 5 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for open coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when short circuit is detected on injector 5 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 655 FMI 4. Is EST DTC list SPN 655 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

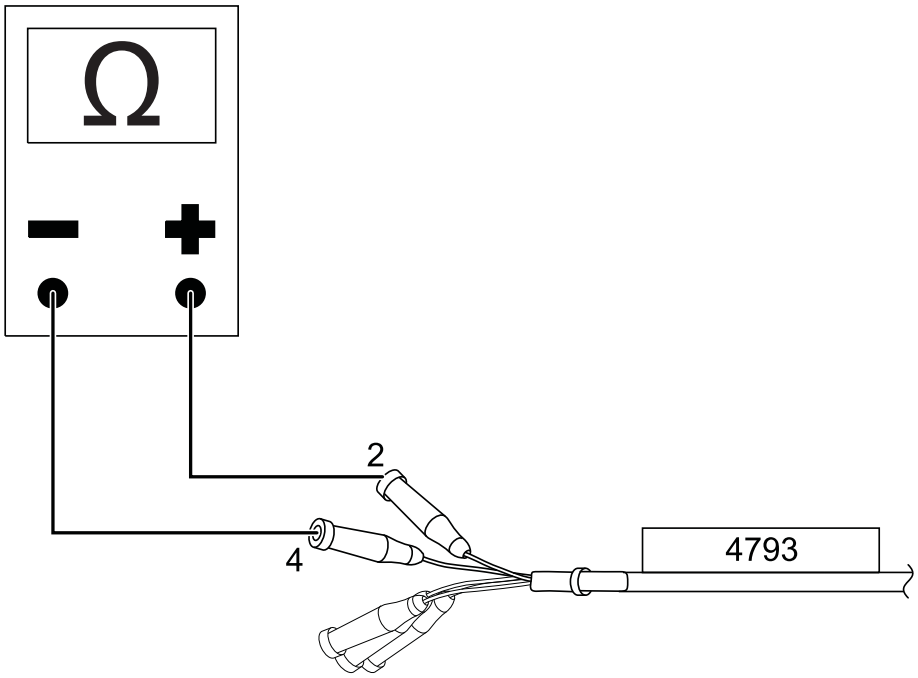
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
A. Key OFF B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 655 FMI 4.

Pin-Point Tests (SPN 655 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

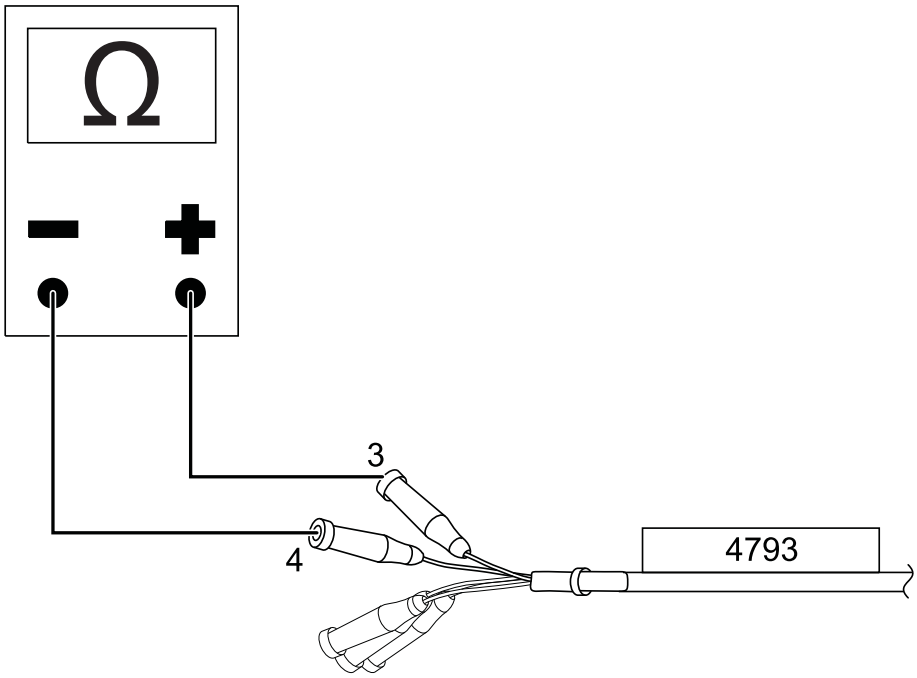


0000326261

Figure 517 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 4 Close and fuel injector 4 Open circuit. After repairs are complete, retest for SPN 655 FMI 4.

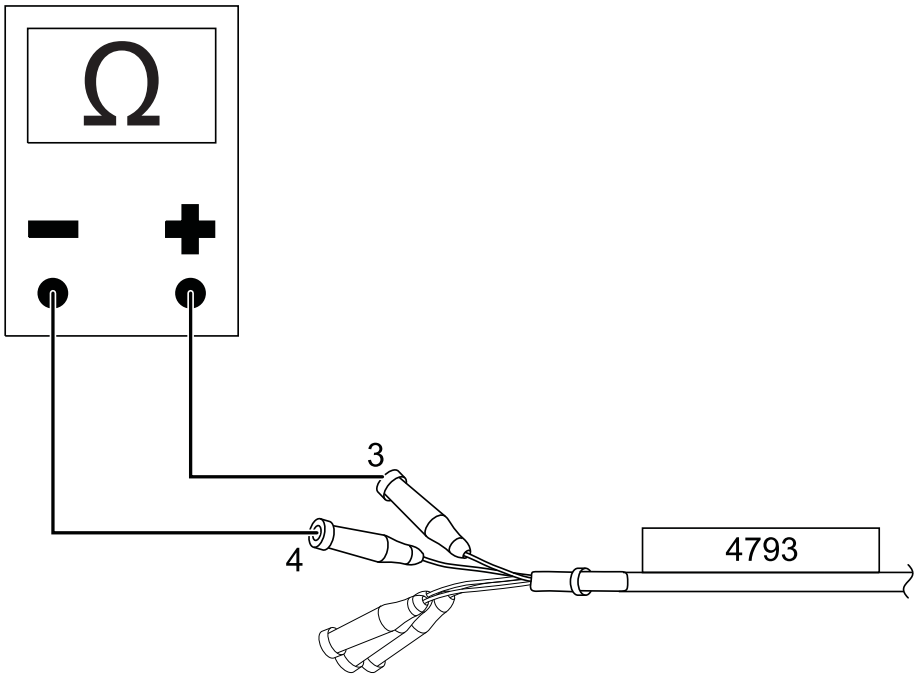


0000326361

Figure 518 Test 2 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326361

Figure 519 Test 3 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 5 Open circuit. After repairs are complete, retest for SPN 655 FMI 4.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 655 FMI 4.

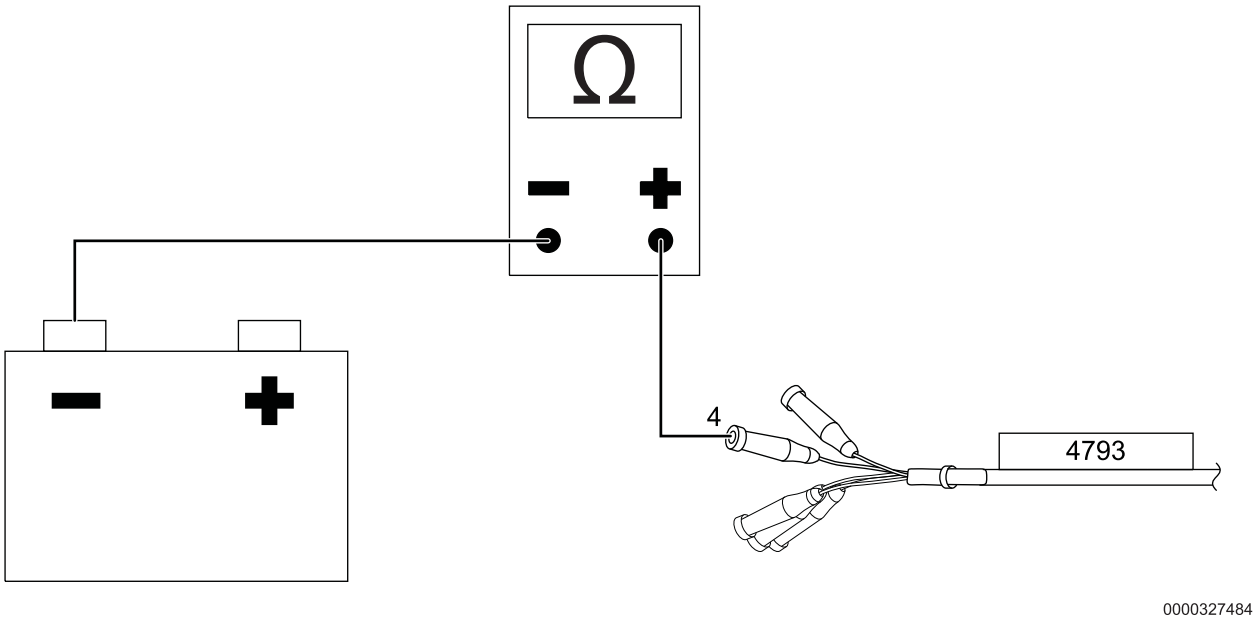


Figure 520 Test 4 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 5 Open H circuit. After repairs are complete, retest for SPN 655 FMI 4.

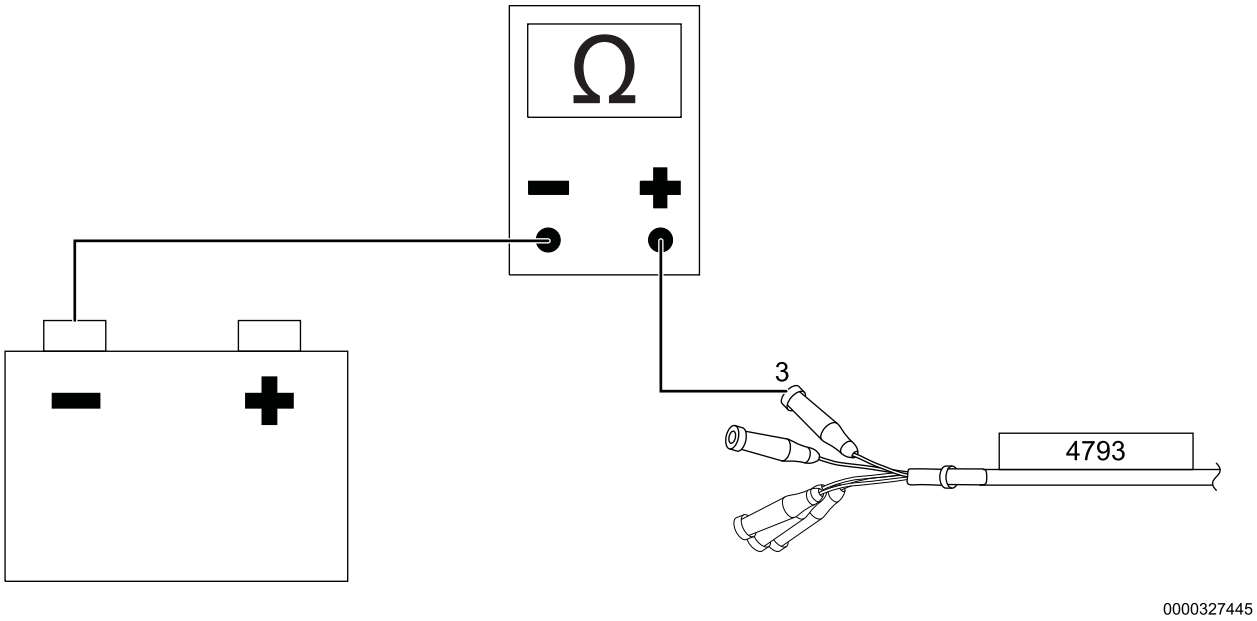


Figure 521 Test 5 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 5 Open L circuit. After repairs are complete, retest for SPN 655 FMI 4.

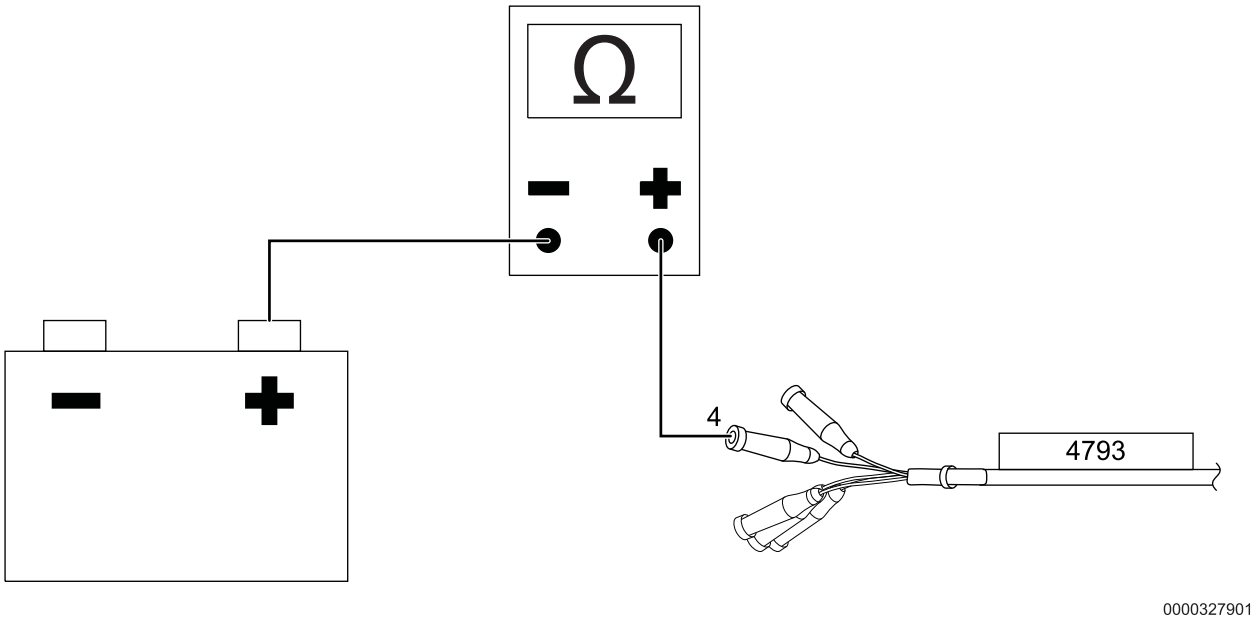


Figure 522 Test 6 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 5 Open L circuit. After repairs are complete, retest for SPN 655 FMI 4.
	No: Repair short to PWR in fuel injector 5 Open H circuit. After repairs are complete, retest for SPN 655 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 655 FMI 4 fault code diagnostics.

SPN 656 FMI 4 - Injector 6 open coil - short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.0004 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 6 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open H shorted to Open L
- Open H short to GND
- Open L short to GND
- Open H short to PWR
- Open L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 656 FMI 4. Is EST DTC list SPN 656 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

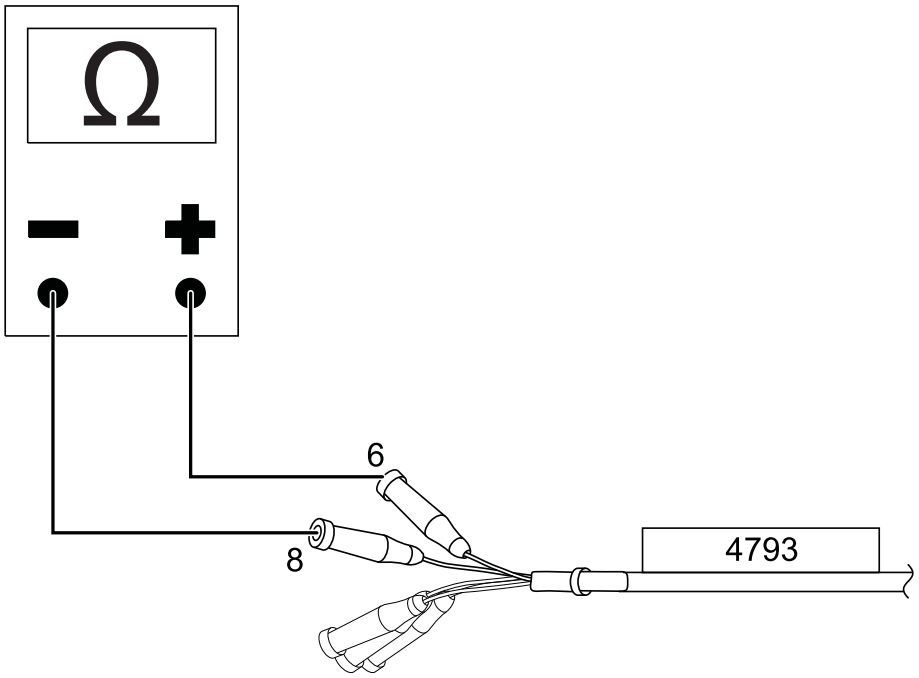
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
A. Key OFF B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 656 FMI 4.

Pin-Point Tests (SPN 656 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

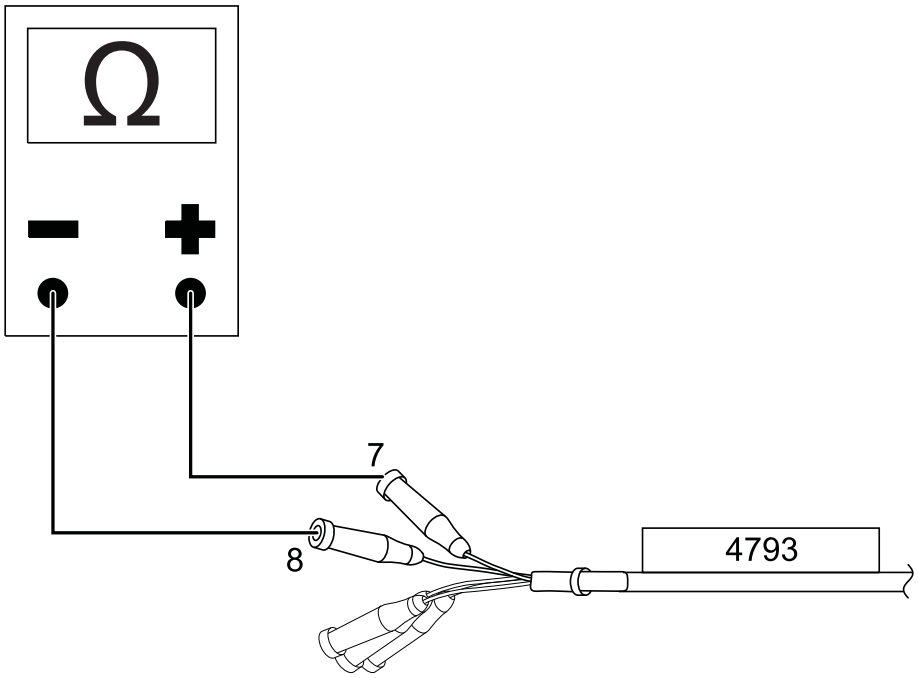


0000326321

Figure 523 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 6 Close and fuel injector 6 Open circuit. After repairs are complete, retest for SPN 656 FMI 4.

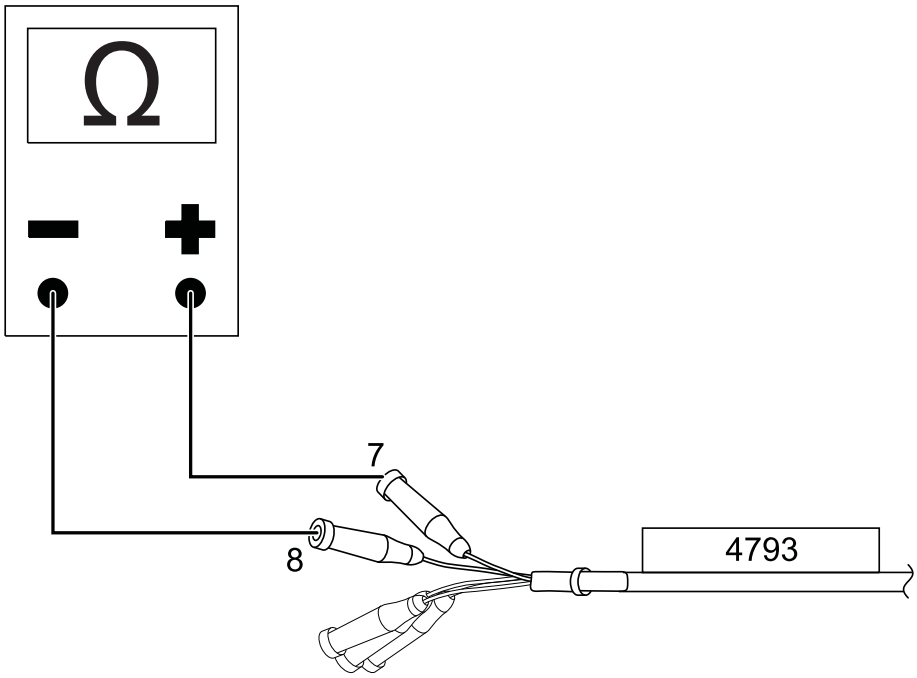


0000326401

Figure 524 Test 2 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326401

Figure 525 Test 3 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 6 Open circuit. After repairs are complete, retest for SPN 656 FMI 4.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 656 FMI 4.

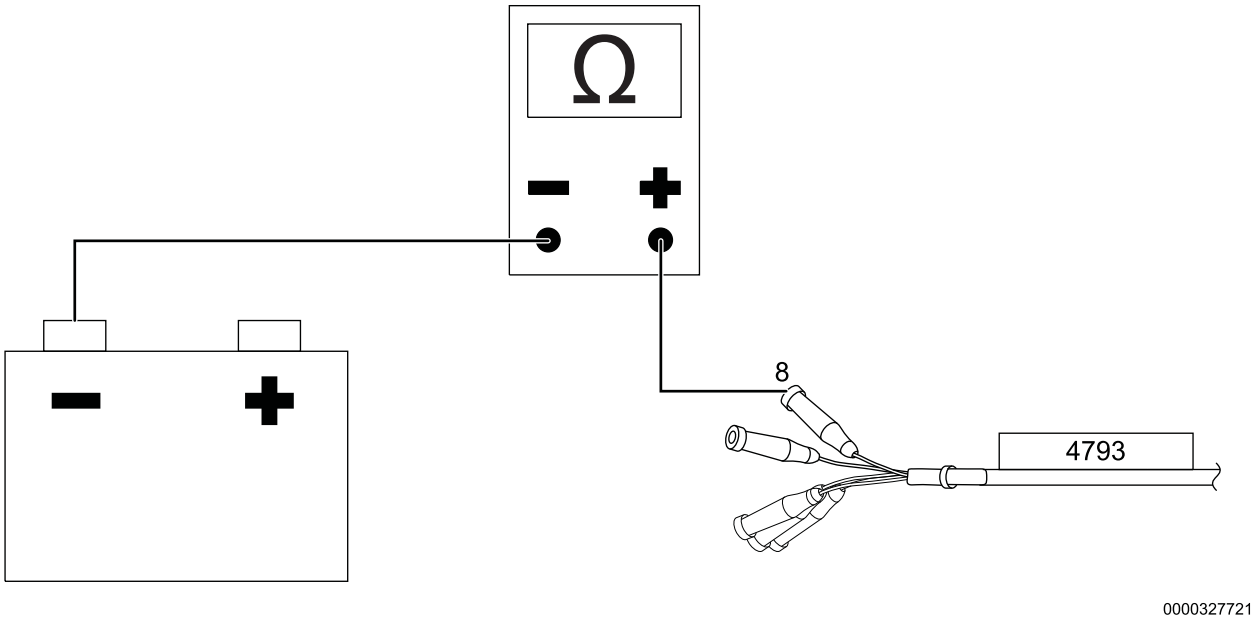


Figure 526 Test 4 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 6 Open H circuit. After repairs are complete, retest for SPN 656 FMI 4.

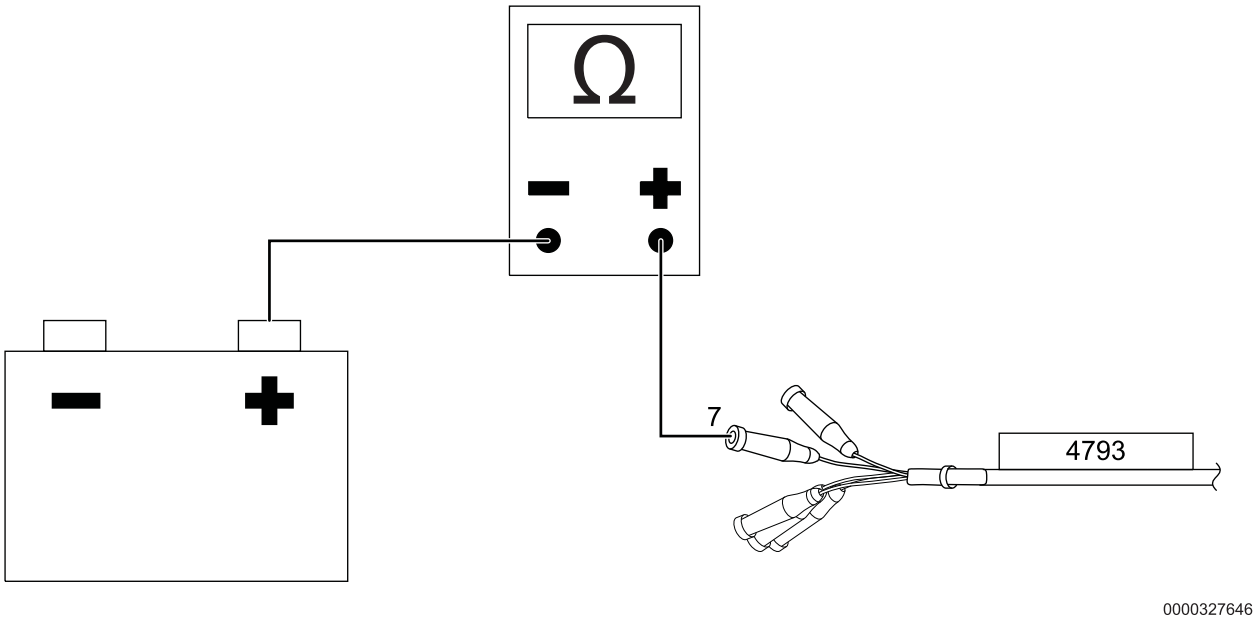


Figure 527 Test 5 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 6 Open L circuit. After repairs are complete, retest for SPN 656 FMI 4.

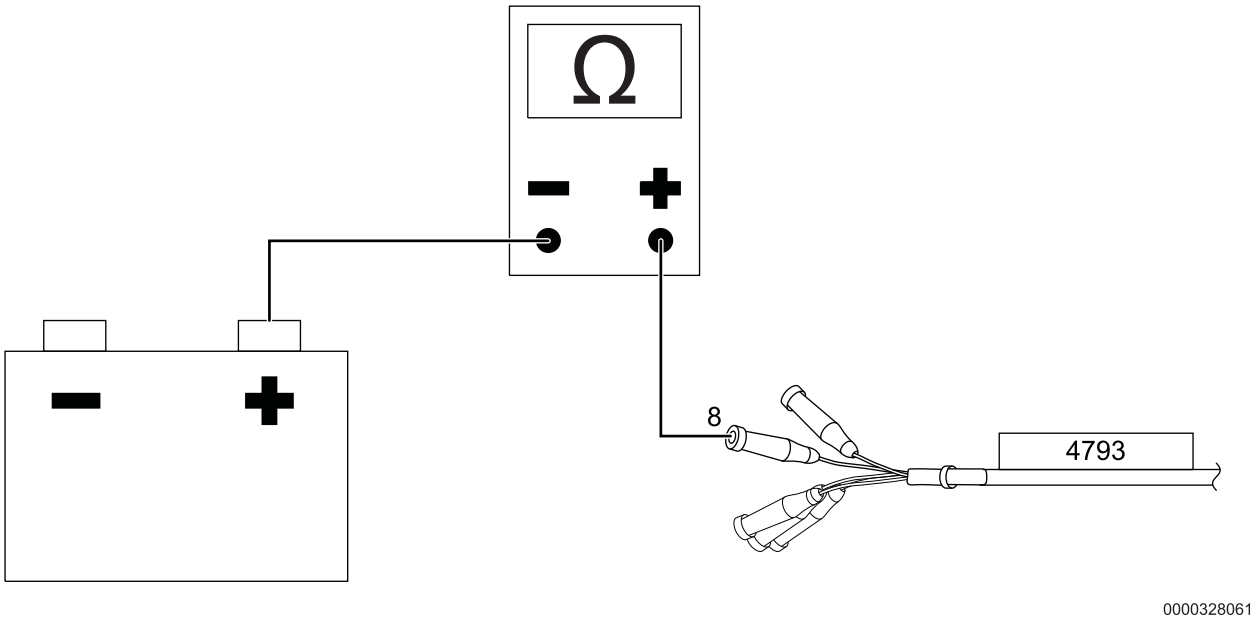


Figure 528 Test 6 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 6 Open L circuit. After repairs are complete, retest for SPN 656 FMI 4.
	No: Repair short to PWR in fuel injector 6 Open H circuit. After repairs are complete, retest for SPN 656 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 656 FMI 4 fault code diagnostics.

SPN 651 FMI 5 - Injector 1 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 1 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 651 FMI 5. Is EST DTC list SPN 651 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

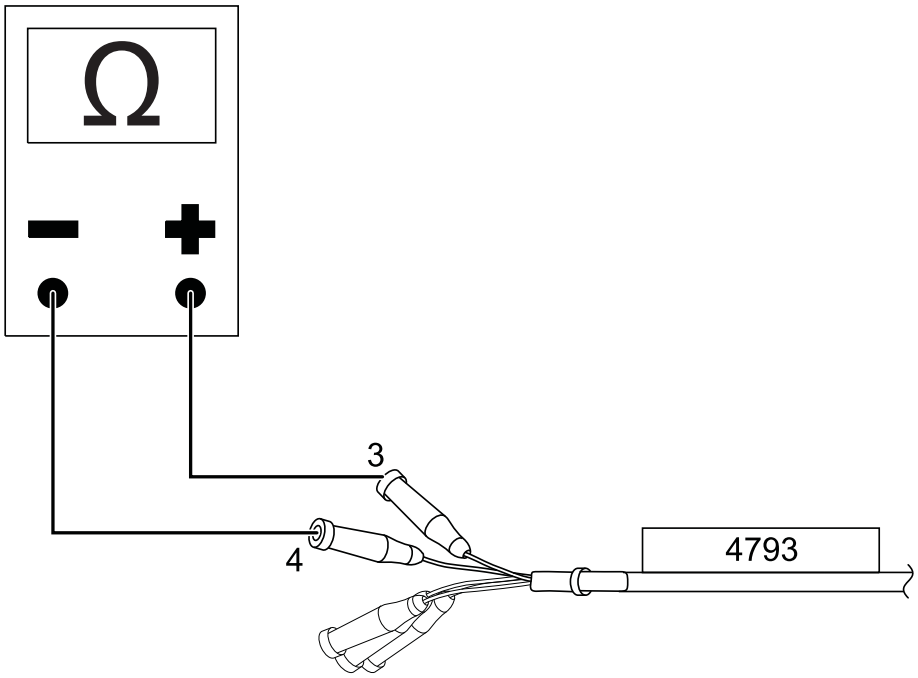
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 651 FMI 5.

Pin-Point Tests (SPN 651 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326361

Figure 529 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 651 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 1. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 651 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 1. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and fuel injector 1 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 651 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 1. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and fuel injector 1 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 651 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 651 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 651 FMI 5 fault code diagnostics.

SPN 652 FMI 5 - Injector 2 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 2 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 652 FMI 5. Is EST DTC list SPN 652 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

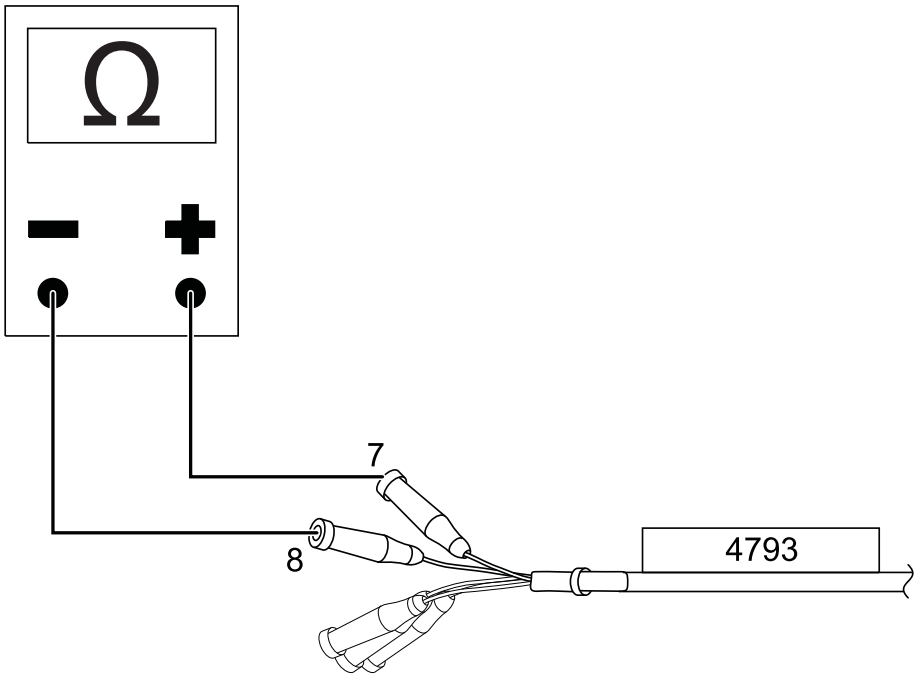
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 652 FMI 5.

Pin-Point Tests (SPN 652 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326401

Figure 530 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 652 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 2. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 652 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 2. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and fuel injector 2 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 652 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 2. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and fuel injector 2 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 652 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 652 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 652 FMI 5 fault code diagnostics.

SPN 653 FMI 5 - Injector 3 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 3 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 653 FMI 5. Is EST DTC list SPN 653 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

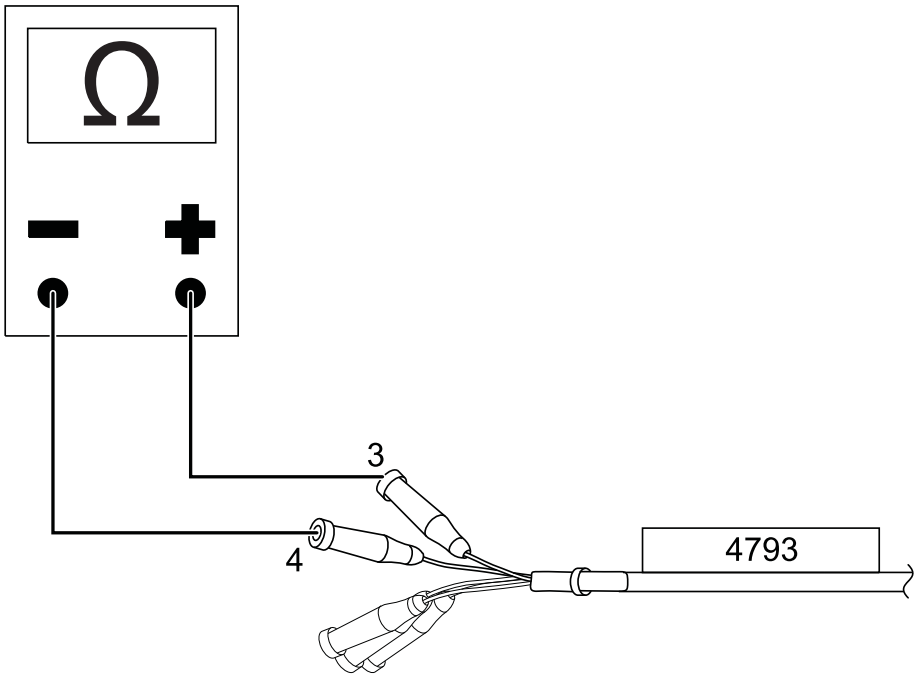
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 653 FMI 5.

Pin-Point Tests (SPN 653 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326361

Figure 531 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 653 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 3. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 653 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 3. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and fuel injector 3 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 653 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 3. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and fuel injector 3 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 653 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 653 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 653 FMI 5 fault code diagnostics.

SPN 654 FMI 5 - Injector 4 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 4 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 654 FMI 5. Is EST DTC list SPN 654 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

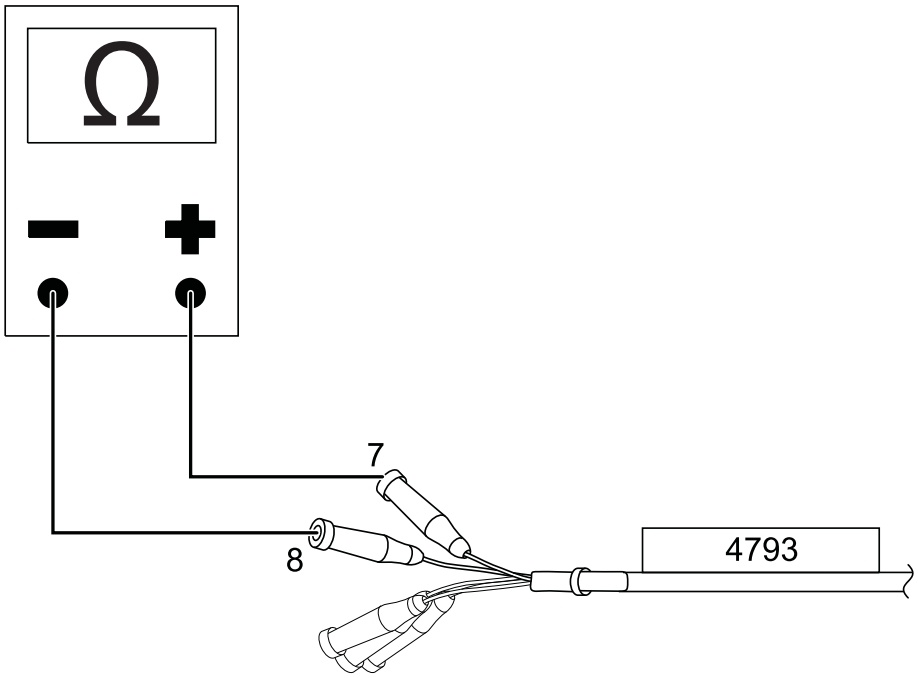
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 654 FMI 5.

Pin-Point Tests (SPN 654 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326401

Figure 532 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 654 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 4. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 654 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 4. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and fuel injector 4 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 654 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 4. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and fuel injector 4 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 654 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 654 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 654 FMI 5 fault code diagnostics.

SPN 655 FMI 5 - Injector 5 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 5 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 655 FMI 5. Is EST DTC list SPN 655 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

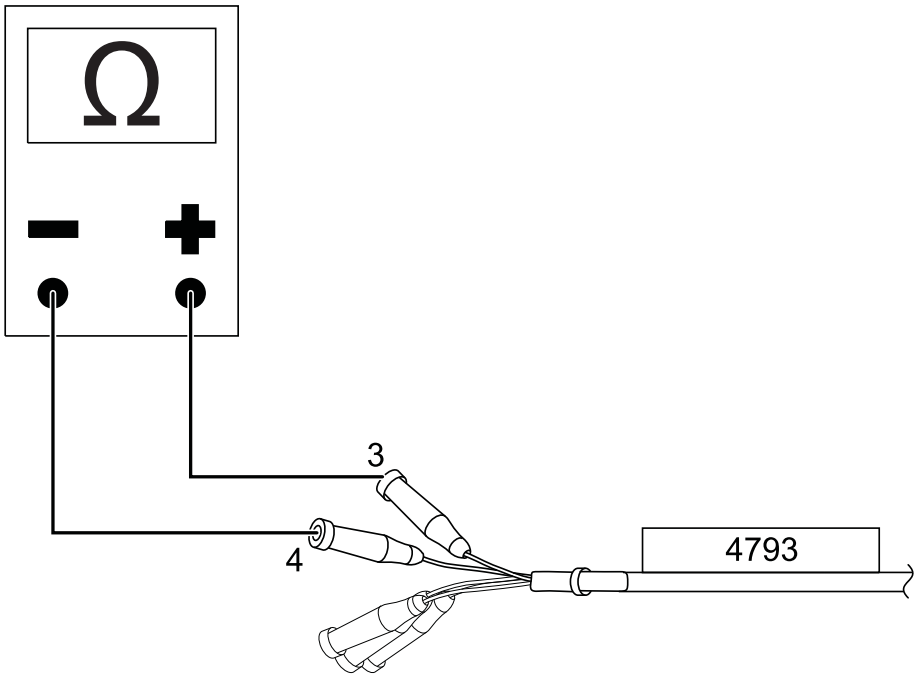
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
A. Key OFF B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 655 FMI 5.

Pin-Point Tests (SPN 655 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 533 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 655 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 5. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 655 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 5. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and fuel injector 5 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 655 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 5. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and fuel injector 4 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 655 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 655 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 655 FMI 5 fault code diagnostics.

SPN 656 FMI 5 - Injector 6 open coil - open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Open Coil	[Current on injector driver circuit > 50 Amps for 0.00035 seconds AND Current Rise time for open coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for open coil > 0.0008 seconds Adaptive Waveform is OFF {Adaptive Waveform is described in Operations Summary document} SPN/FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 6 Open coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 656 FMI 5. Is EST DTC list SPN 656 FMI 5 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

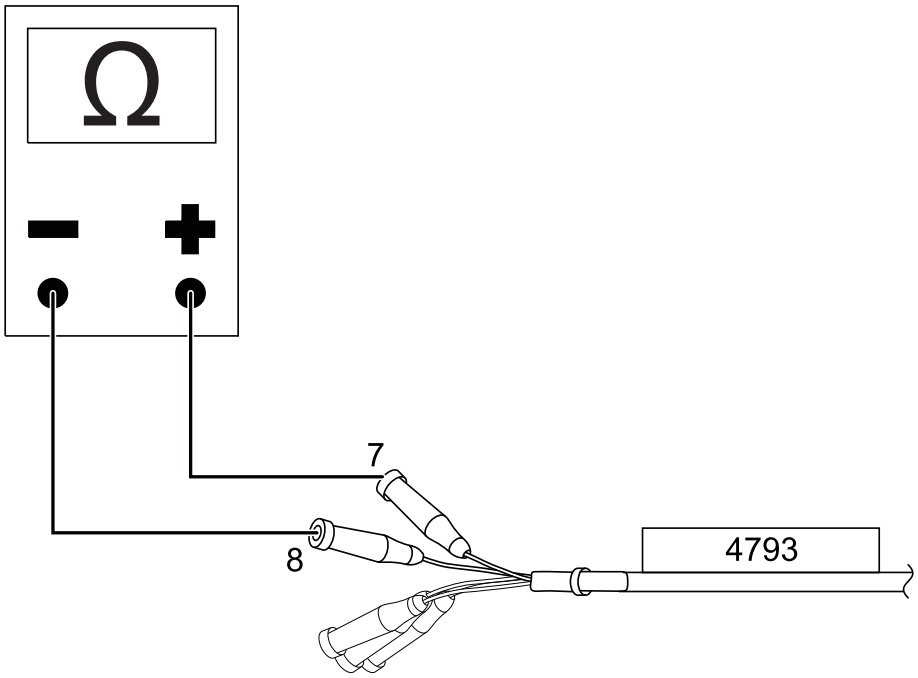
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
A. Key OFF B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 656 FMI 5.

Pin-Point Tests (SPN 656 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326401

Figure 534 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 656 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover C. Disconnect fuel injector 6. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2 and pin 3.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-2 and pin-3.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 656 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 6. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 2.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and fuel injector 6 pin-2.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 656 FMI 4.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 6. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 3.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and fuel injector 6 pin-3.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Open H or Open L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 656 FMI 5.
	No: Repair Open in UVC harness Open L circuit. After repairs are complete, retest for SPN 656 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 656 FMI 5 fault code diagnostics.

SPN 651 - 656 FMI 7 - Injector 1 (through 6) Spool Motion Compensation Max Authority Reached

Condition / Description	Setting Criteria	Enable Conditions / Values
Injector Spool motion max authority reached.	Average coil end of motion adaptation time (Calculated based on back Counter Electro Motive Force (CEMF) 0.0006552 seconds or > 0.001025 seconds	Injection Control Pressure (ICP) > 3191 psi (22 MPa) and < 4931 psi (34 MPa) Engine speed > 1500 rpm Minimum number of close loop samples to calculate average value of adaptation ≥ 100 samples Engine Oil Temperature (EOT) > 158°F (70°C) Time between two consecutive adaptations ≥ 18000 seconds Main injection time duration ≥ 0.0012 seconds AND ≤ 0.0018 seconds Adaptive Waveform and Negative current strategy is OFF {Adaptive Waveform and Negative current strategy is described in Operations Summary document} A reference value must be saved

Fault Overview

Fault code sets when Engine Control Module (ECM) determines fuel injector spool motion compensation has reached its maximum allowable time limit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Final number of Suspect Parameter Number (SPN) identifies affected injector, and name in ServiceMaxx™ software identifies cylinder in which the injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Incorrect Engine Control Module (ECM) programming
- Failed fuel injector

Step 1	Check for injector replacement.	Decision
Identify if affected fuel injector was recently replaced. Has affected fuel injector been recently replaced?		Yes: Perform Injector Close End of Motion (CEOM) Reset Procedure (page 2114). After repairs are complete, retest for SPN 651- 656 FMI 7.
		No: Replace affected injector and perform Injector Close End of Motion (CEOM) Reset Procedure (page 2114). After repairs are complete, retest for SPN 651- 656 FMI 7.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 651 - 656 FMI 7 remains, verify if each step was completed correctly and the proper decision was made. Notify supervisor for further action.

SPN 651 FMI 14 - Injector 1 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel Quantity, Pressure and Timing deviation HIGH for Single Injector. Comparison of cylinder balance difference between two consecutive cylinders. Cylinder balance difference is calculated based on segment time.	Cylinder balance difference (dimensionless quantity) • Automatic Transmission; > 0.1699 • Manual Transmission; > 0.1101 "AND" [Pattern detection cylinder balance difference value • Automatic Transmission; < -0.05005 • Manual Transmission; < -0.001221 for = 3 cylinders]	Particulate Filter Regeneration NOT Active End Of Line Testing NOT Active Engine coolant Temperature > -58°F (-50°C) AND < 248°F (120°C) Selective Catalytic Reduction (SCR) Warm-up NOT Active Engine Manifold Pressure < 17.4 psi (119.9 kPa) Battery Voltage > 9 Volts Battery Voltage (Per Global Disable Mask) ≥ 9 Volts AND ≤ 16 Volts Mass fueling ≥ 0 mg/stroke AND ≤ 116.7 mg/stroke Vehicle Speed ≥ 0 mph AND ≤ 3.107 mph Engine Speed ≥ 650 RPM AND ≤ 850 RPM Filter Stabilization Time > 10 seconds Pressure Control Valve Command < 100% Engine Air Intake Temperature > -40°F (-40°C) AND < 212°F (100°C) Fuel Temperature > -58°F (-50°C) Engine Oil Temperature > 95°F (35°C) SPN/FMI's 132/3, 132/4, 132/0, 132/1, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 175/3,4, 175/2, 164/0, 164/3,4, 3055/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 191/4, 191/3, 5395/0, 5395/1, 2659/20, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31, 3055/2,

		4257/7, 651/7, 652/7, 653/7, 654/7, 655/7, 656/7 are NOT Active
	Cylinder balance difference (dimensionless quantity) • Automatic Transmission; < -0.22 • Manual Transmission; < -0.46 "AND" [Pattern detection cylinder balance difference value > 0.03491 for = 3 cylinders]	Particulate Filter Regeneration NOT Active End Of Line Testing NOT Active Engine coolant Temperature > -58°F (-50°C) AND < 248°F (120°C) Selective Catalytic Reduction (SCR) Warm-up NOT Active Engine Manifold Pressure < 17.4 psi (119.9 kPa) Battery Voltage > 9 Volts Battery Voltage (Per Global Disable Mask) ≥ 9 Volts AND ≤ 16 Volts Mass fueling ≥ 0 mg/stroke AND ≤ 116.7 mg/stroke Vehicle Speed ≥ 0 mph AND ≤ 3.107 mph Engine Speed ≥ 650 RPM AND ≤ 850 RPM Filter Stabilization Time > 10 seconds Pressure Control Valve Command < 100% Engine Air Intake Temperature > -40°F (-40°C) AND < 212°F (100°C) Fuel Temperature > -58°F (-50°C) Engine Oil Temperature > 95°F (35°C) SPN/FMI's 132/3, 132/4, 132/0, 132/1, 108/3,4, 636/7, 636/2, 110/3,4, 110/2, 175/3,4, 175/2, 164/0, 164/3,4, 3055/2, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 5543/3, 5543/4, 5543/5, 94/3, 94/4, 1189/3,4, 3464/11, 51/7, 51/7, 51/3, 51/4, 2791/2, 2791/7, 2791/14, 2791/14, 2791/14, 27/14, 2791/8, 2791/8, 2791/3,4, 191/4, 191/3, 5395/0, 5395/1, 2659/20, 1323/31, 1324/31, 1325/31, 1326/31, 1327/31, 1328/31, 1322/31, 3055/2, 4257/7, 651/7, 652/7, 653/7, 654/7, 655/7, 656/7 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 651 FMI 14. Is EST DTC list SPN 651 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 651 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 651 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 651 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 651 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 651 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 651 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10. No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 651 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12. No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8. No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 651 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer. No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 651 FMI 14.

Pin-Point Tests (SPN 651 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

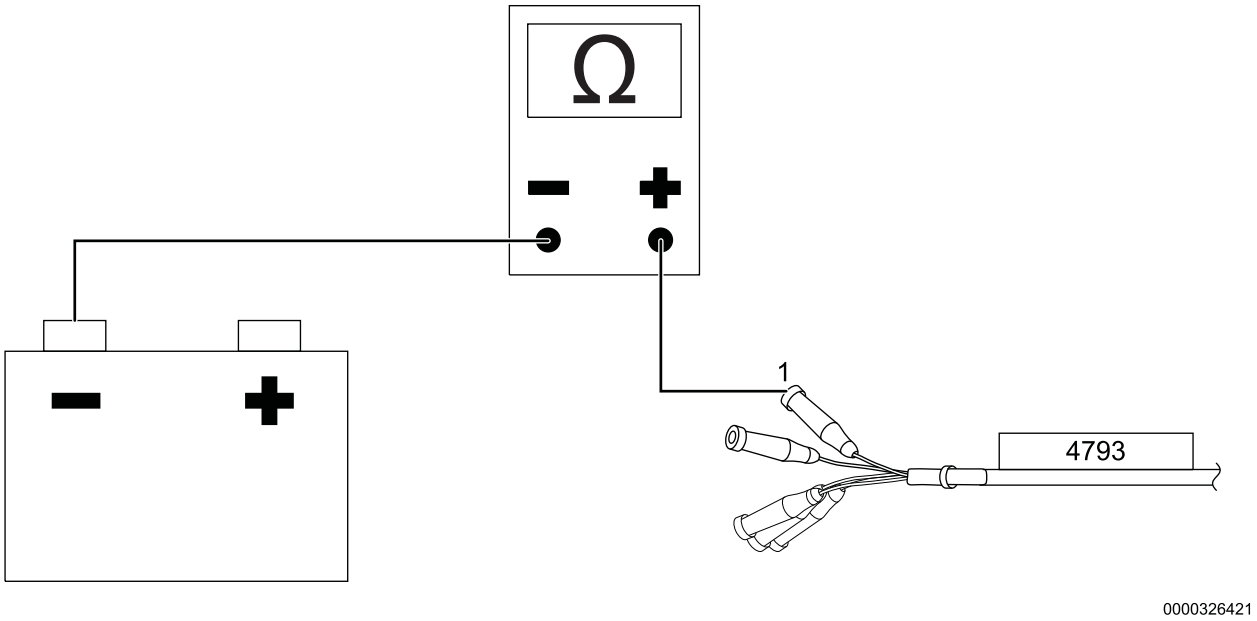


Figure 535 Test 1 Injector 1 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 2.

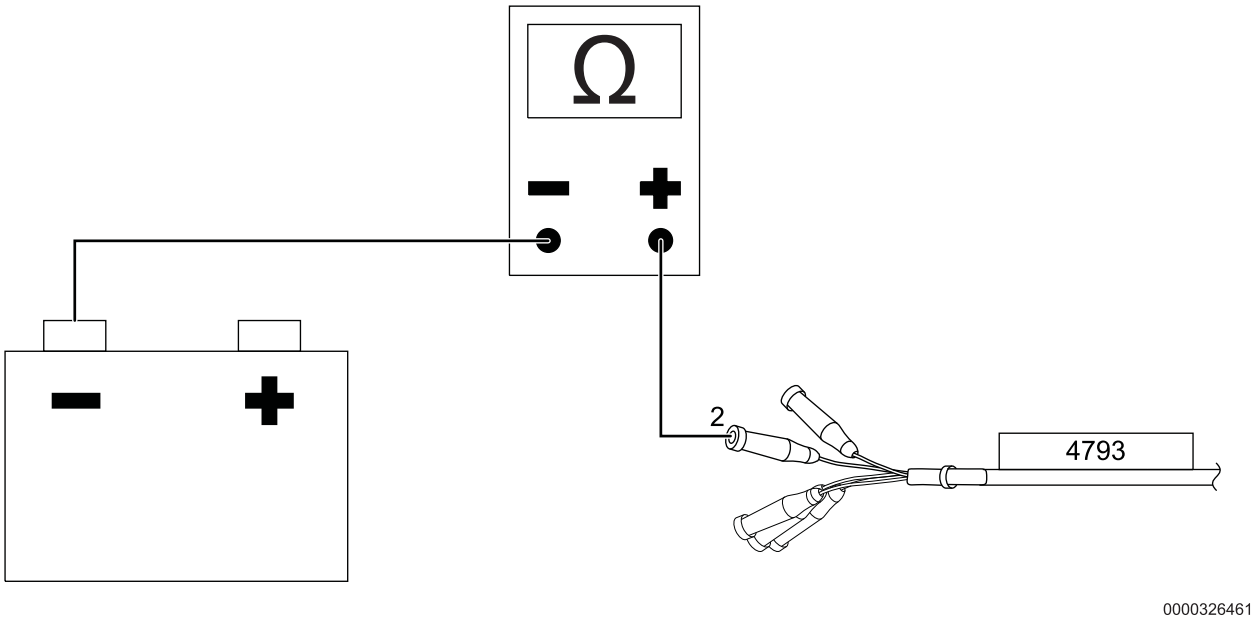


Figure 536 Test 2 Injector 1 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 3.

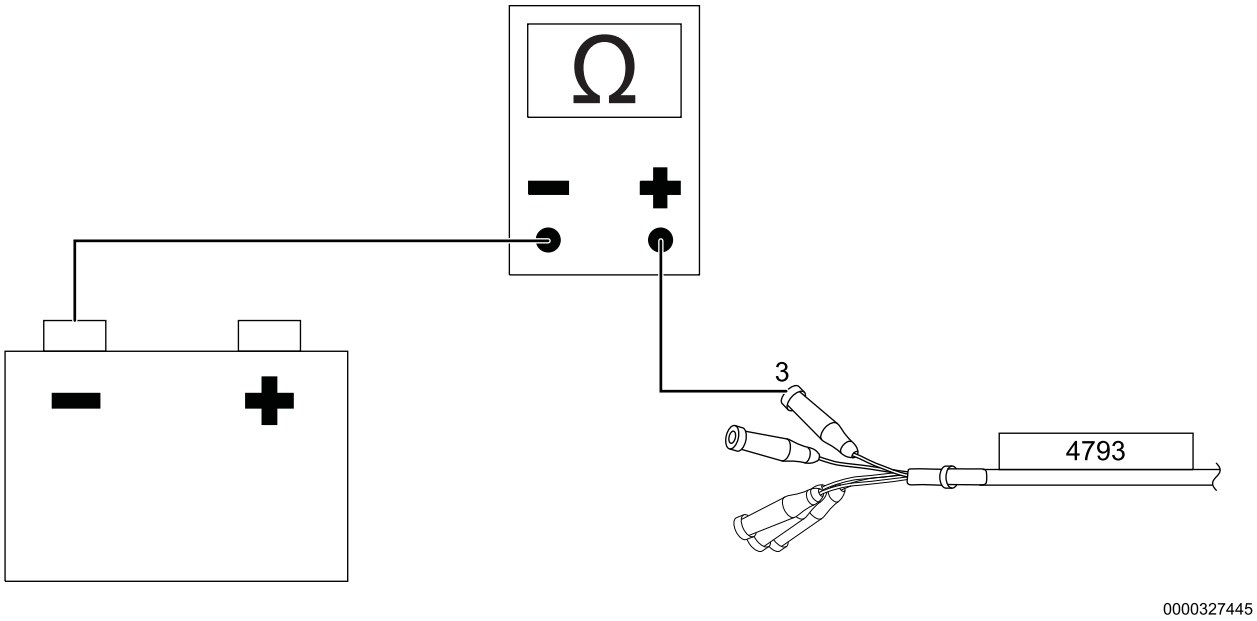


Figure 537 Test 3 Injector 1 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 4.

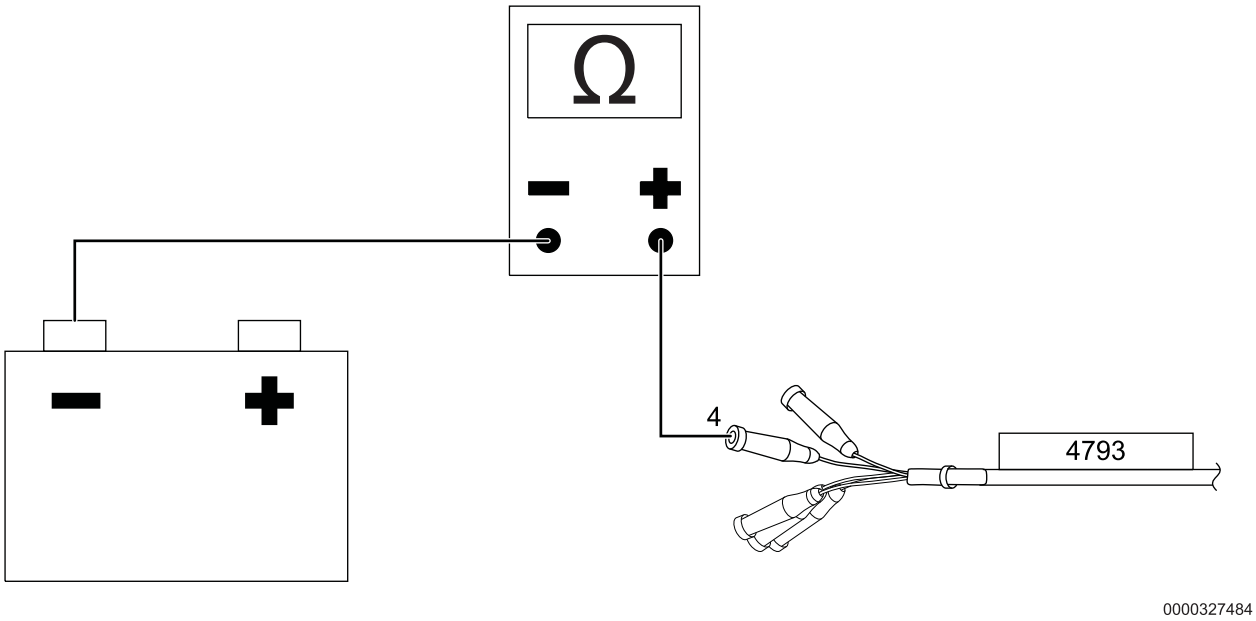
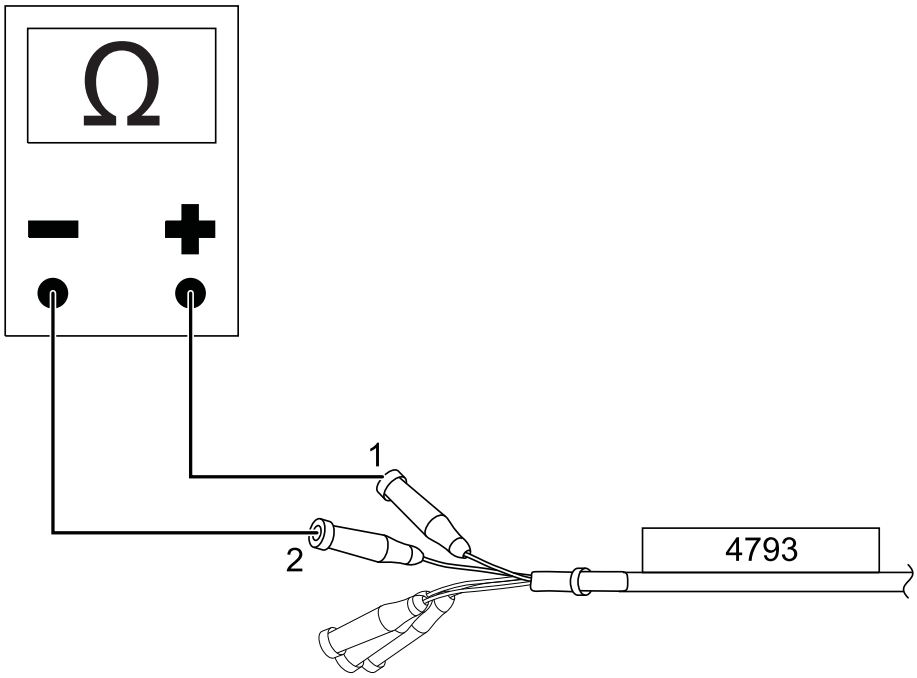


Figure 538 Test 4 Injector 1 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 5.

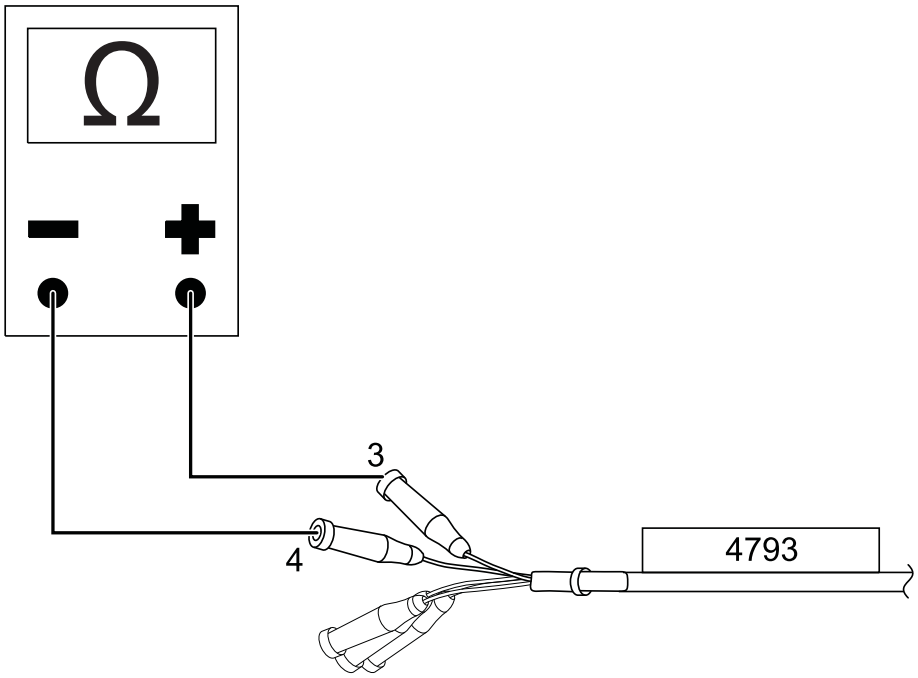


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Figure 539 Test 5 Injector 1 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 6.

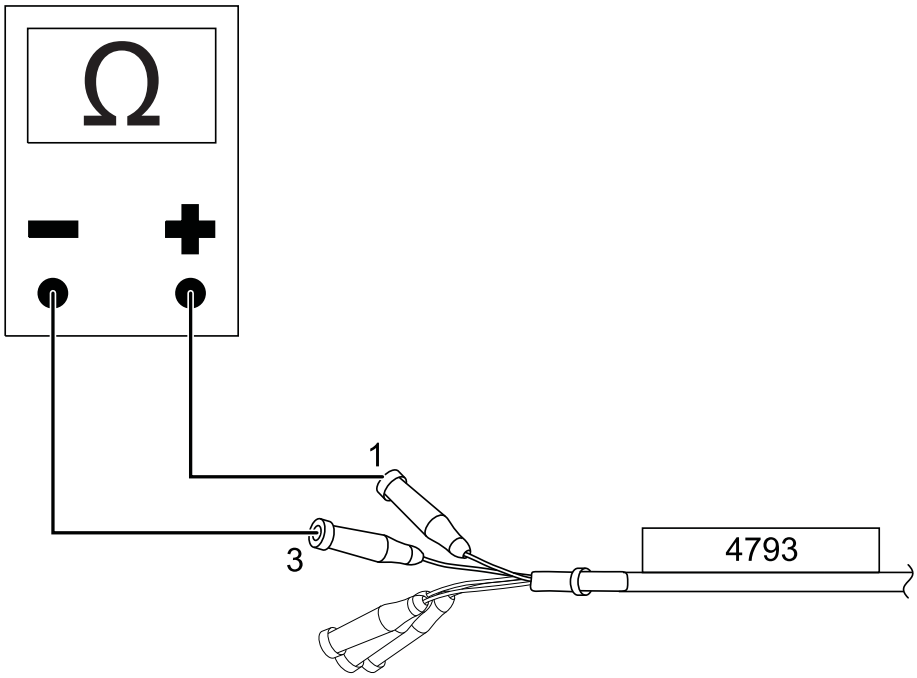


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Figure 540 Test 6 Injector 1 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 7.



0000326241

Figure 541 Test 7 Injector 1 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 1 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 1 and leave Injector 1 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 1 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 1 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 1 and leave Injector 1 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 1 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 1 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 1 and leave Injector 1 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 1 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 651 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 651 FMI 14 fault code diagnostics.

SPN 652 FMI 14 - Injector 2 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 651 FMI 14 for this table		

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 652 FMI 14. Is EST DTC list SPN 652 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 652 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 652 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 652 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 652 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 652 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 652 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10.
		No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 652 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12.
		No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8.
		No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 652 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer.
		No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 652 FMI 14.

Pin-Point Tests (SPN 652 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

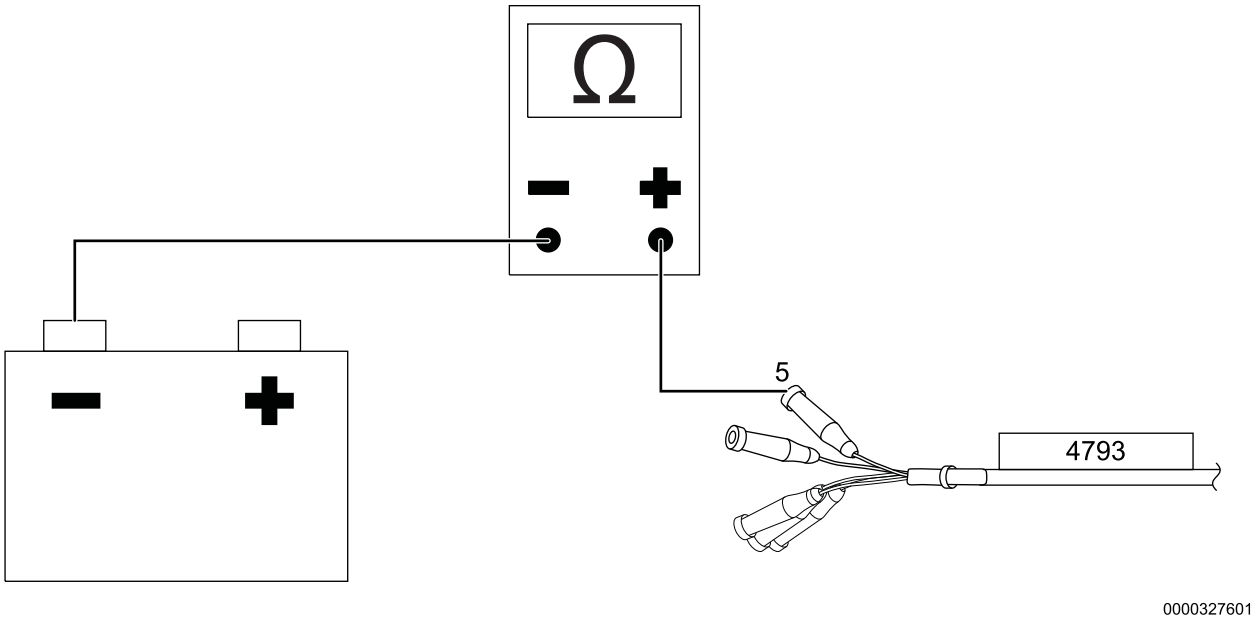


Figure 542 Test 1 Injector 2 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 2.

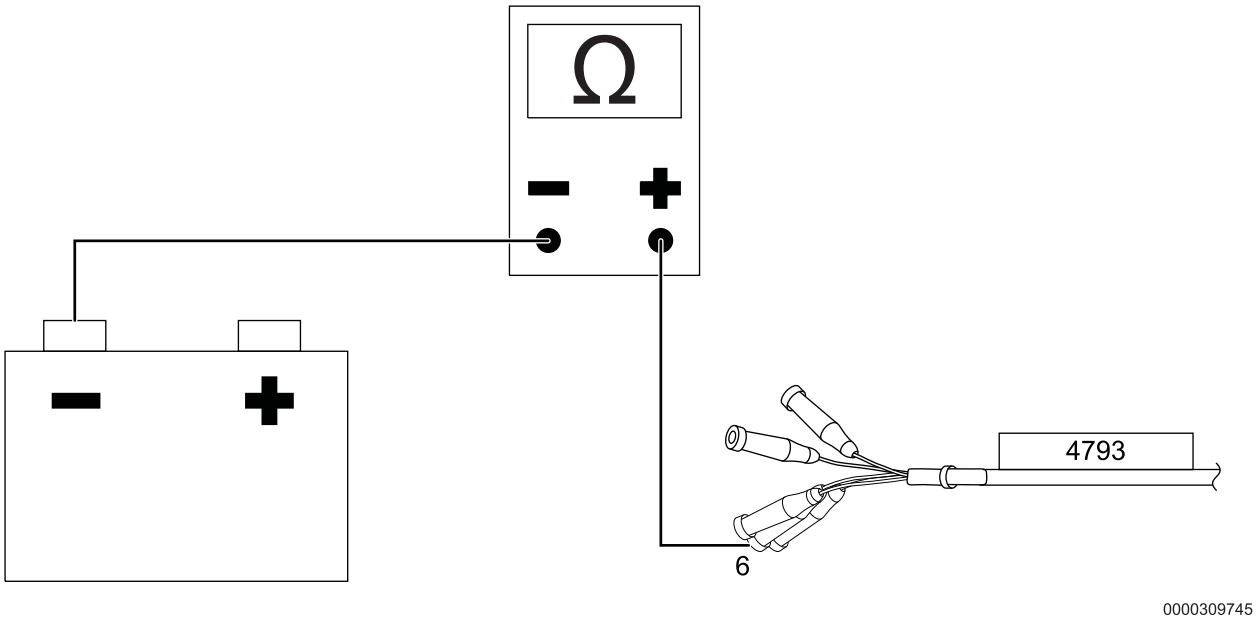


Figure 543 Test 2 Injector 2 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 3.

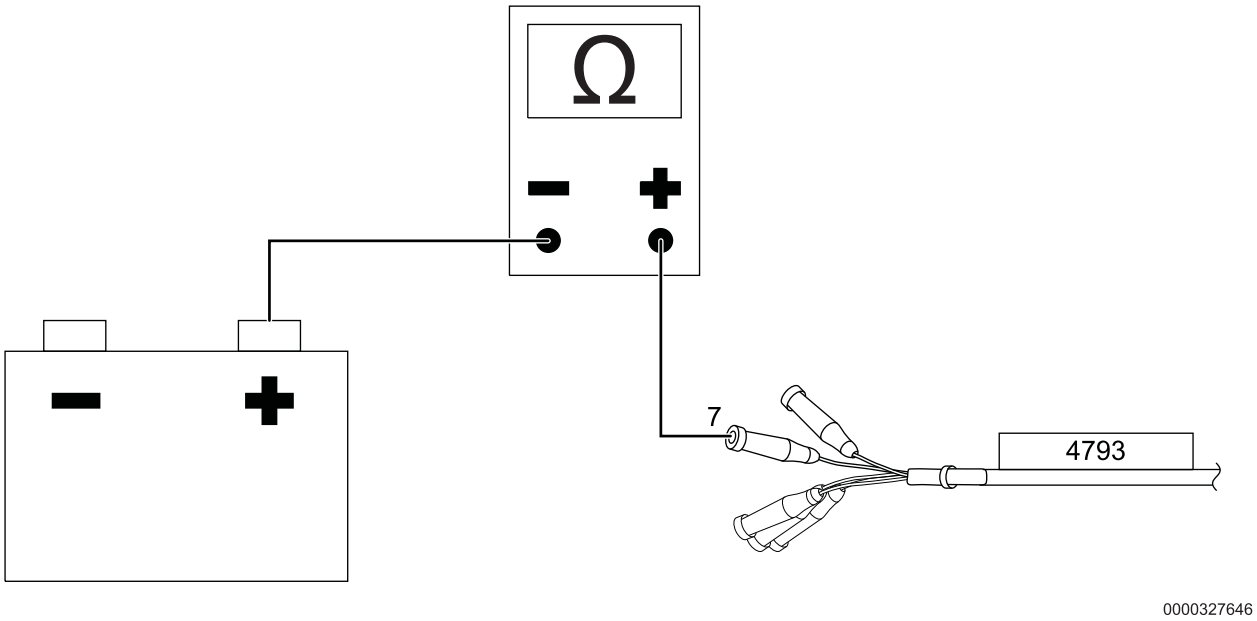


Figure 544 Test 3 Injector 2 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 4.

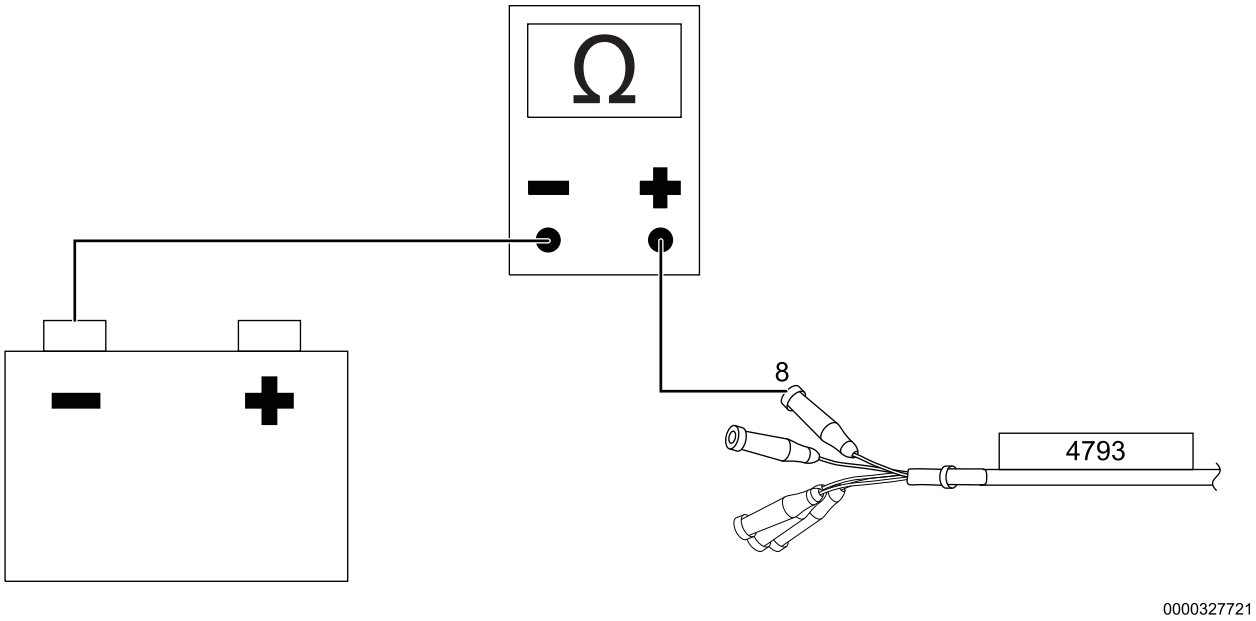
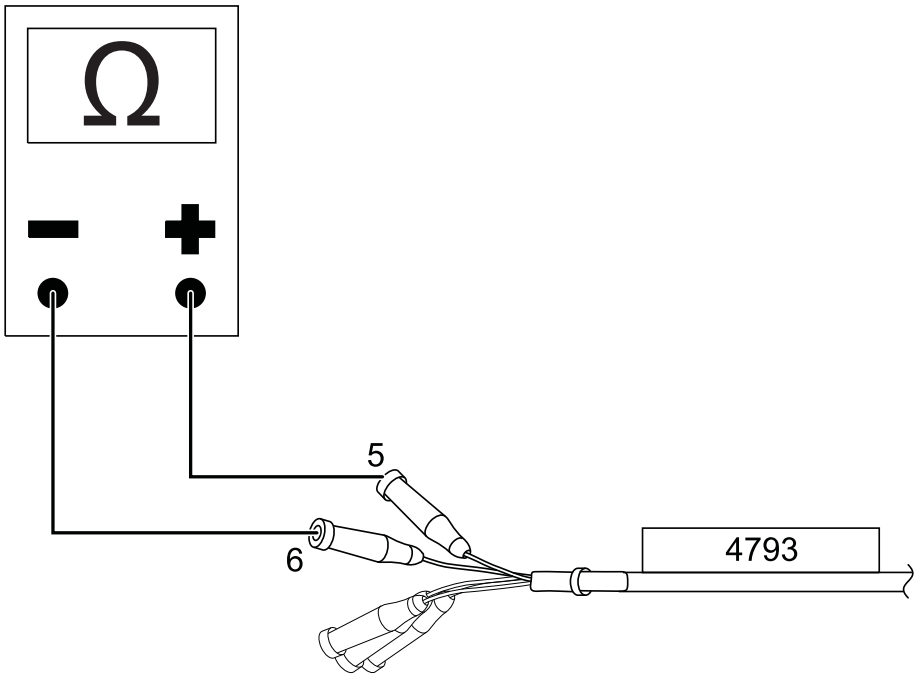


Figure 545 Test 4 Injector 2 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 5.

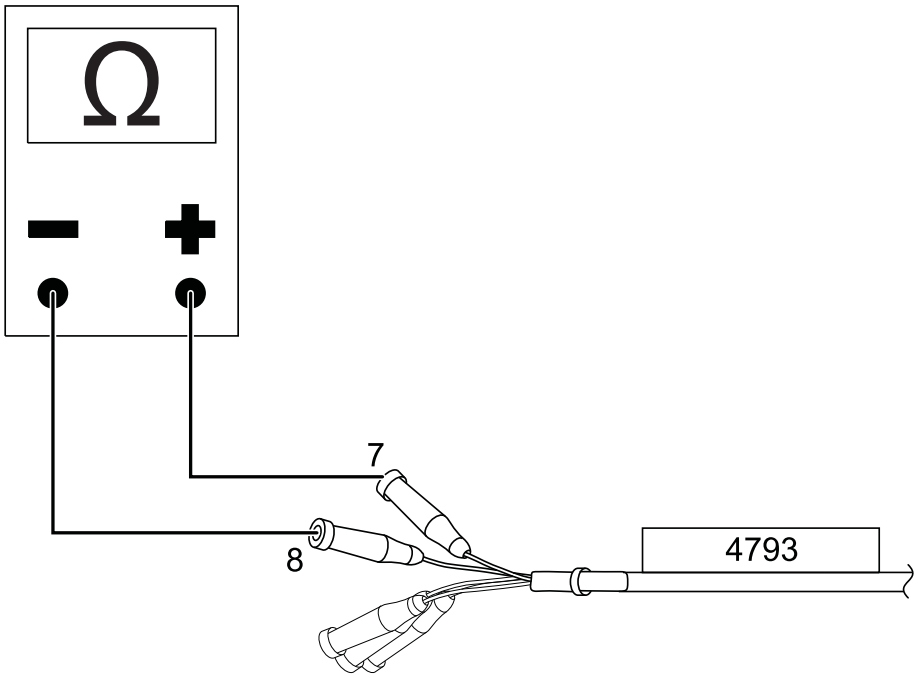


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Figure 546 Test 5 Injector 2 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 6.

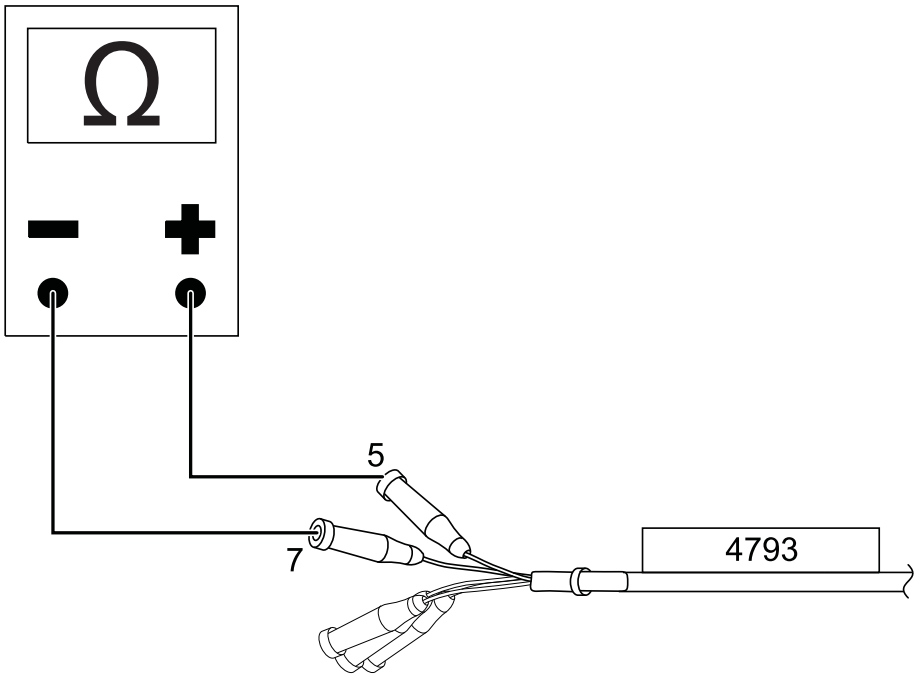


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Figure 547 Test 6 Injector 2 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 7.



0000326281

Figure 548 Test 7 Injector 2 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 2 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 2 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 2 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 2 and leave Injector 2 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 2 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 2 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 2 and leave Injector 2 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 2 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 2 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 2 and leave Injector 2 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 2 pin-3 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 652 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 652 FMI 14 fault code diagnostics.

SPN 653 FMI 14 - Injector 3 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 651 FMI 14 for this table		

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 653 FMI 14. Is EST DTC list SPN 653 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 653 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 653 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 653 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 653 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 653 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 653 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10. No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 653 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12. No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8. No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 653 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer. No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 653 FMI 14.

Pin-Point Tests (SPN 653 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

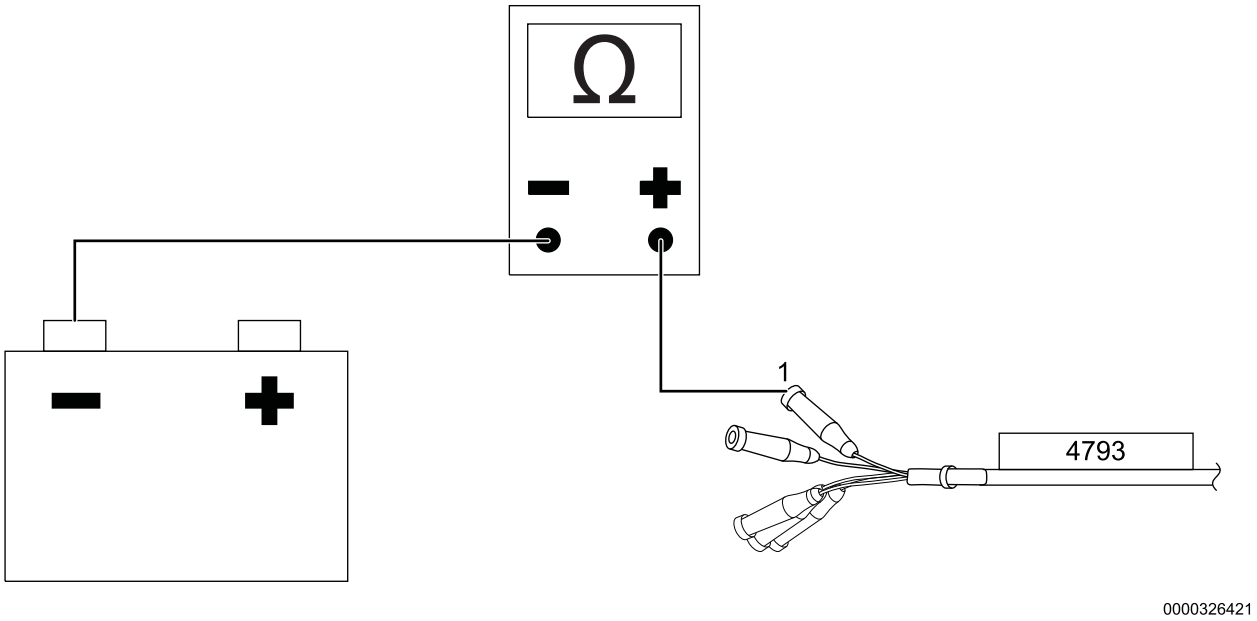


Figure 549 Test 1 Injector 3 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 2.

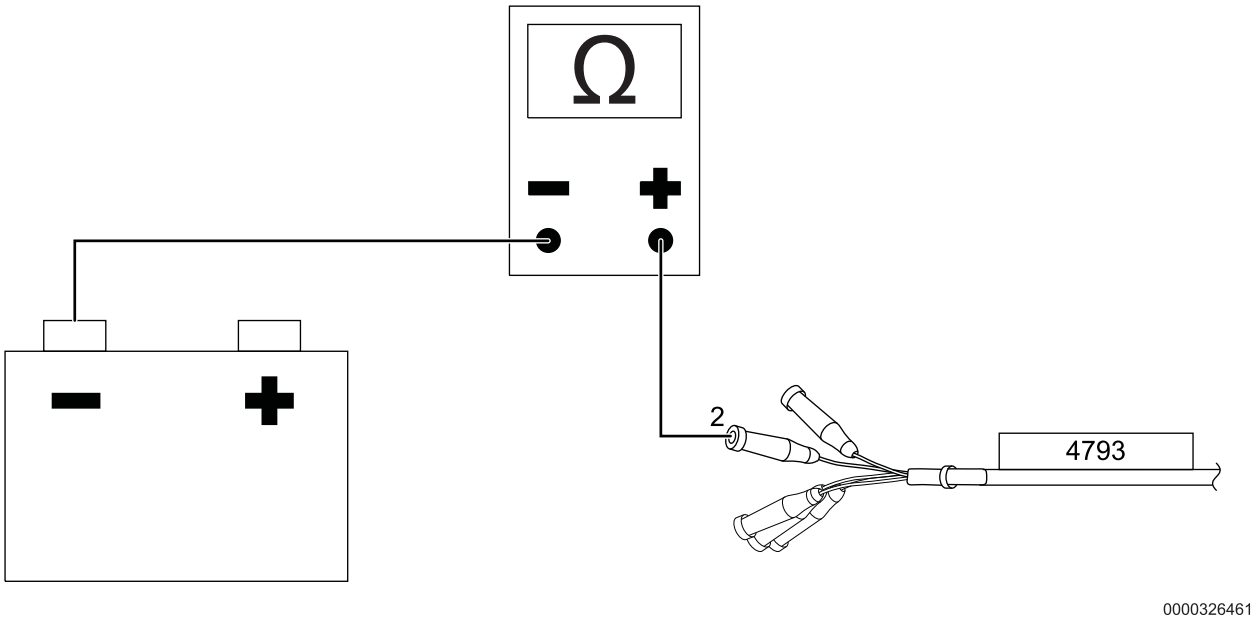


Figure 550 Test 2 Injector 3 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 3.

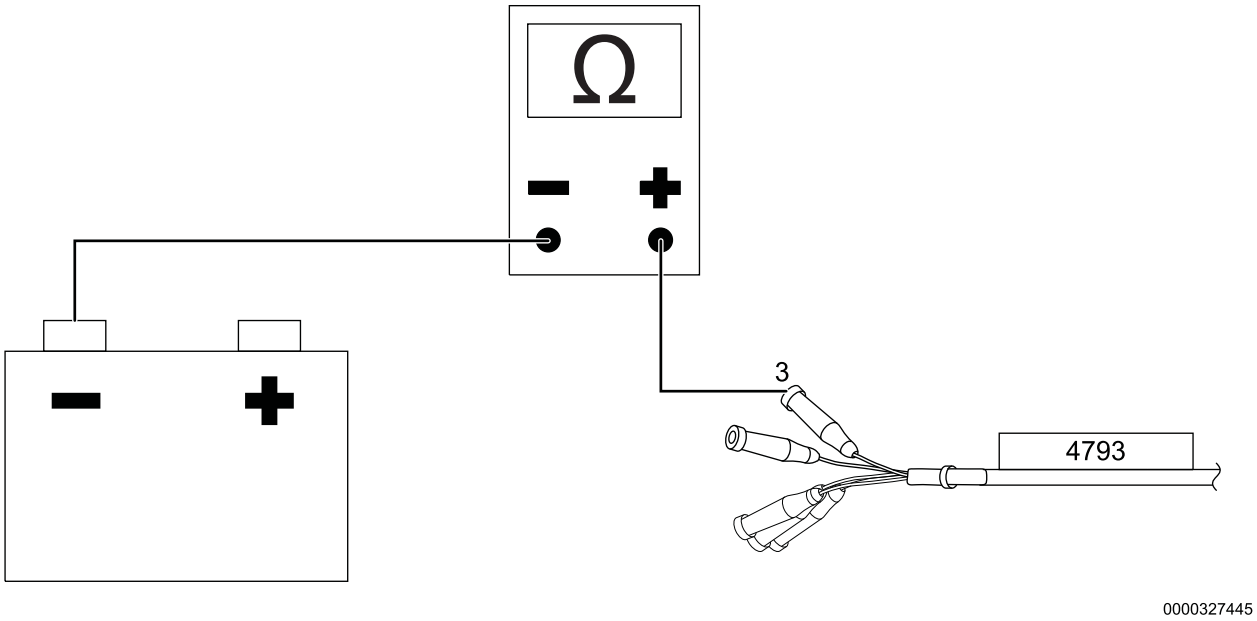


Figure 551 Test 3 Injector 3 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 4.

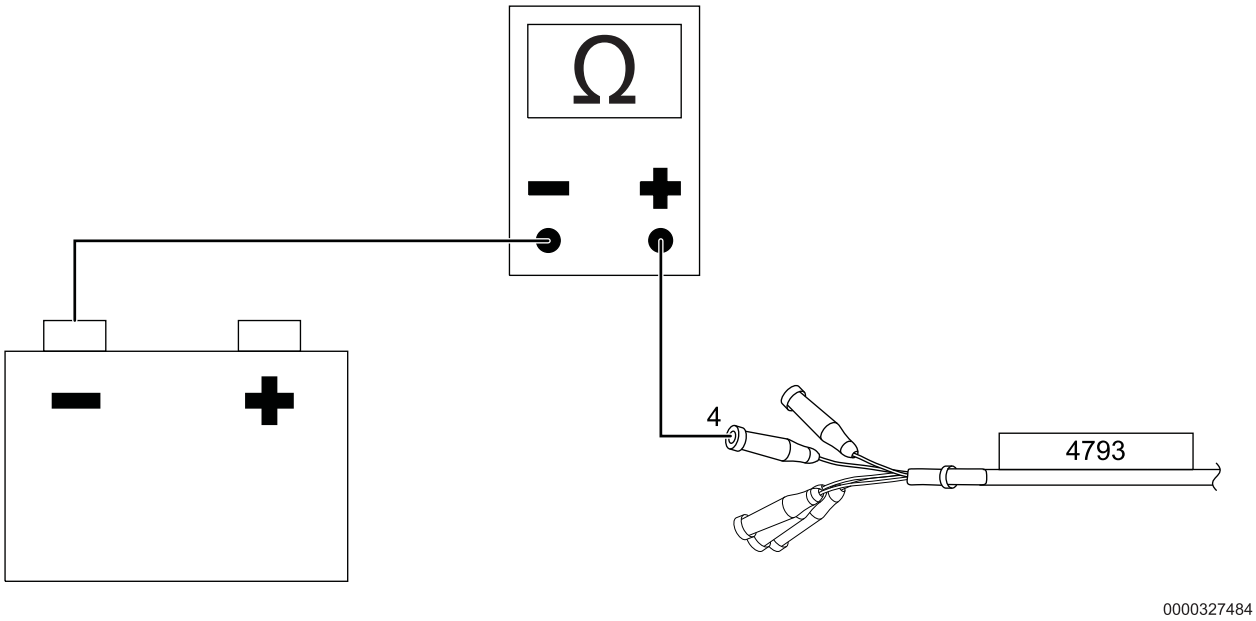
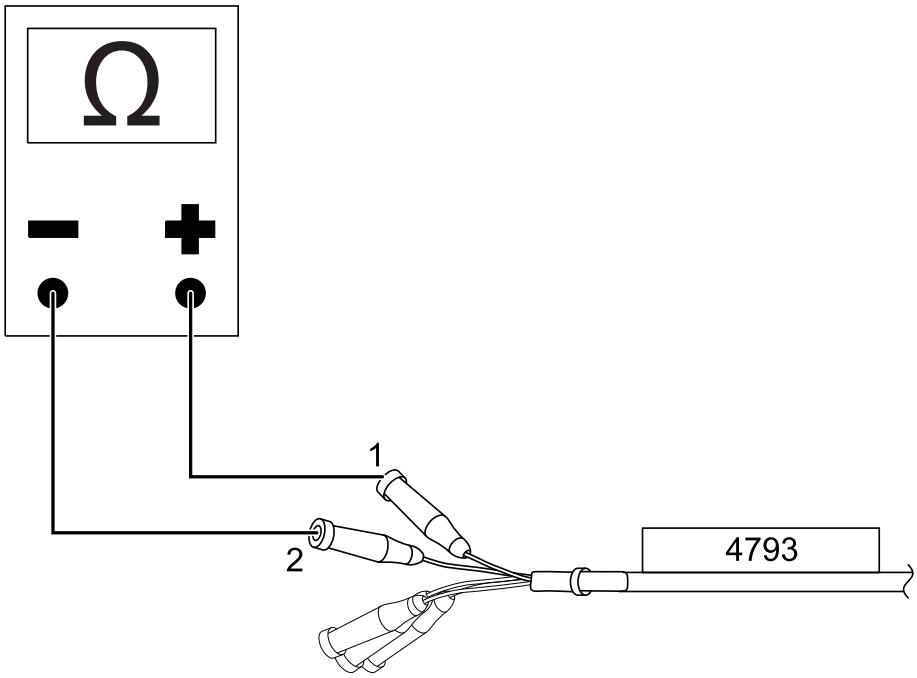


Figure 552 Test 4 Injector 3 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 5.

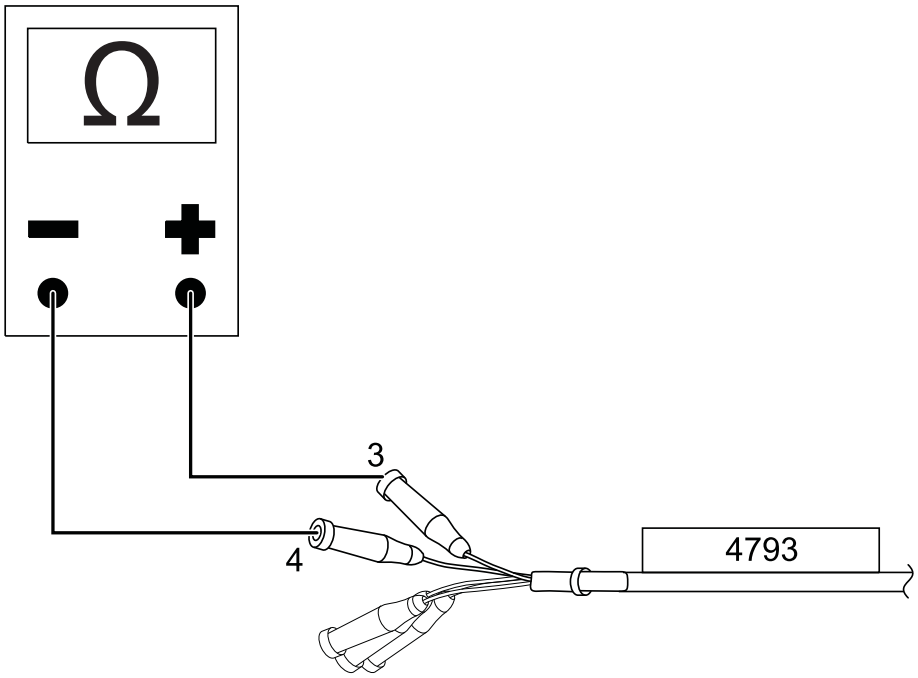


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Figure 553 Test 5 Injector 3 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 6.

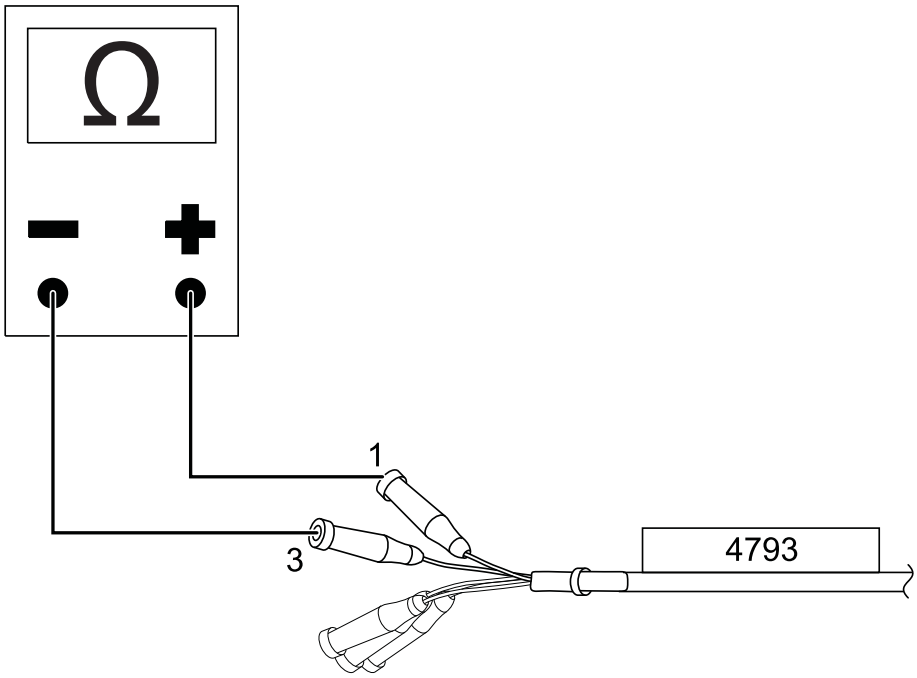


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Figure 554 Test 6 Injector 3 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 7.



0000326241

Figure 555 Test 7 Injector 3 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 3 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 3 and leave Injector 3 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 3 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 3 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 3 and leave Injector 3 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 3 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 3 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 3 and leave Injector 3 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 3 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 653 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 653 FMI 14 fault code diagnostics.

SPN 654 FMI 14 - Injector 4 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 651 FMI 14 for this table		

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 654 FMI 14. Is EST DTC list SPN 654 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 654 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 654 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 654 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 654 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 654 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 654 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10. No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 654 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12. No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8. No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 654 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer. No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 654 FMI 14.

Pin-Point Tests (SPN 654 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

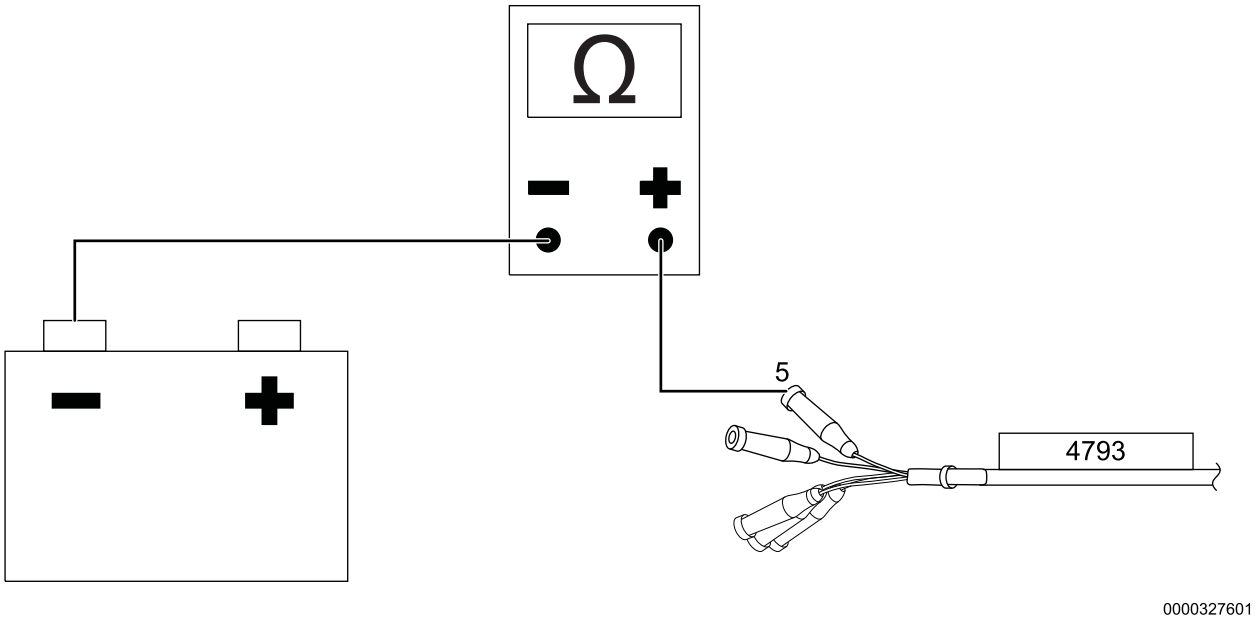


Figure 556 Test 1 Injector 4 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 2.

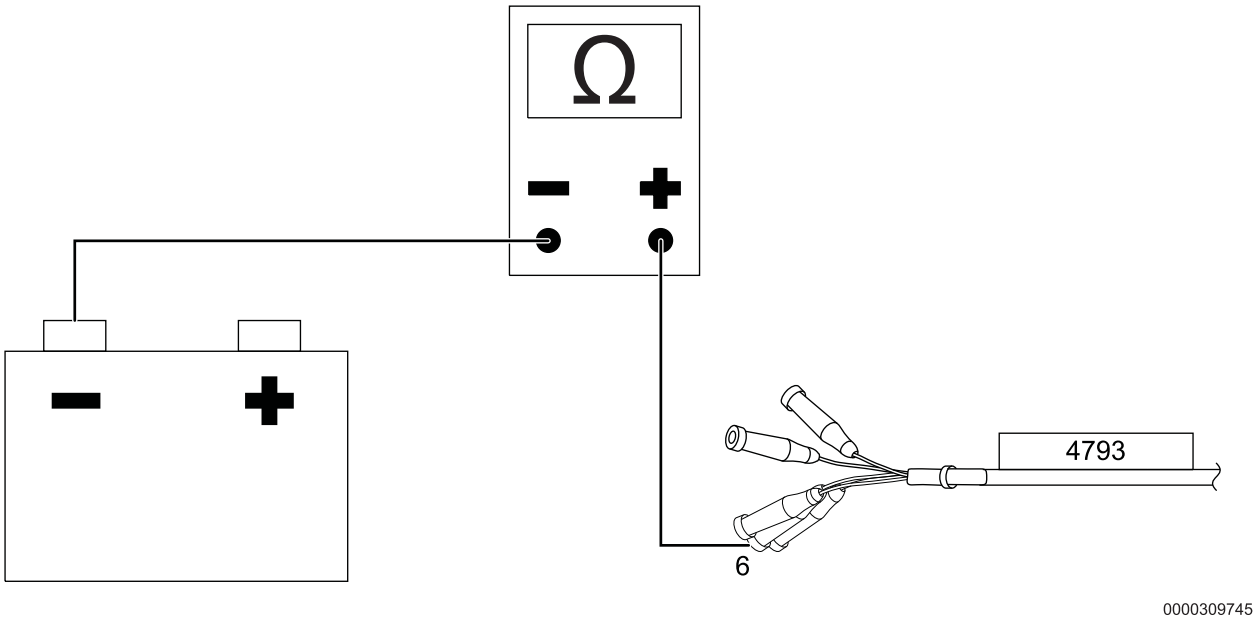


Figure 557 Test 2 Injector 4 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 3.

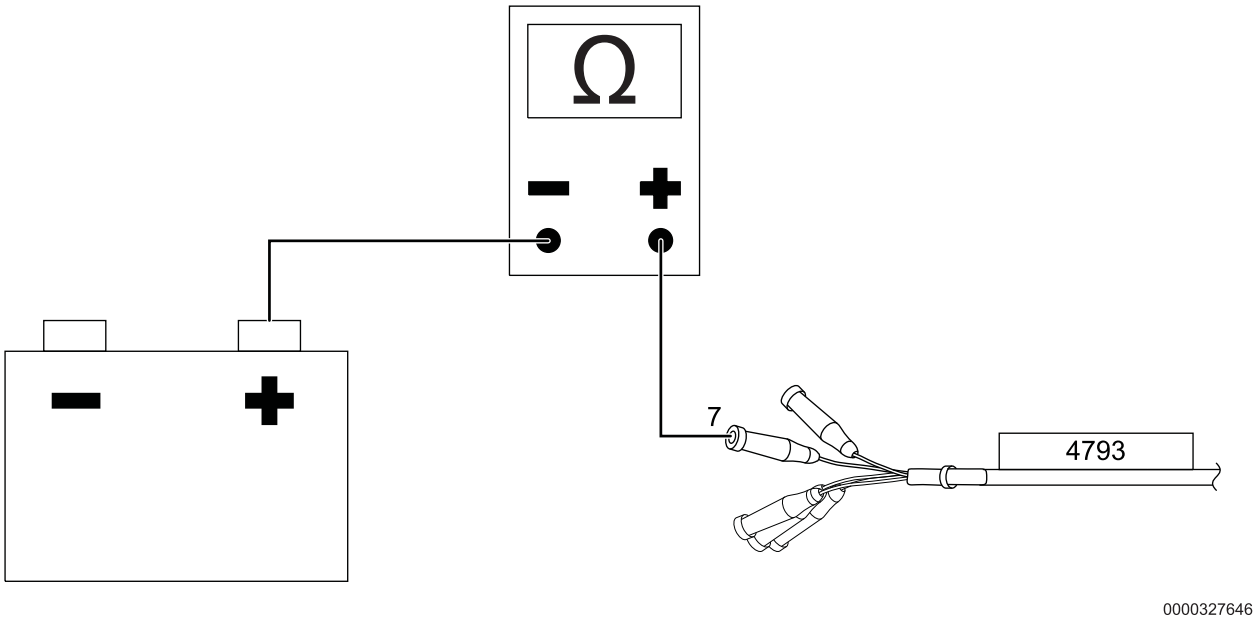


Figure 558 Test 3 Injector 4 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 4.

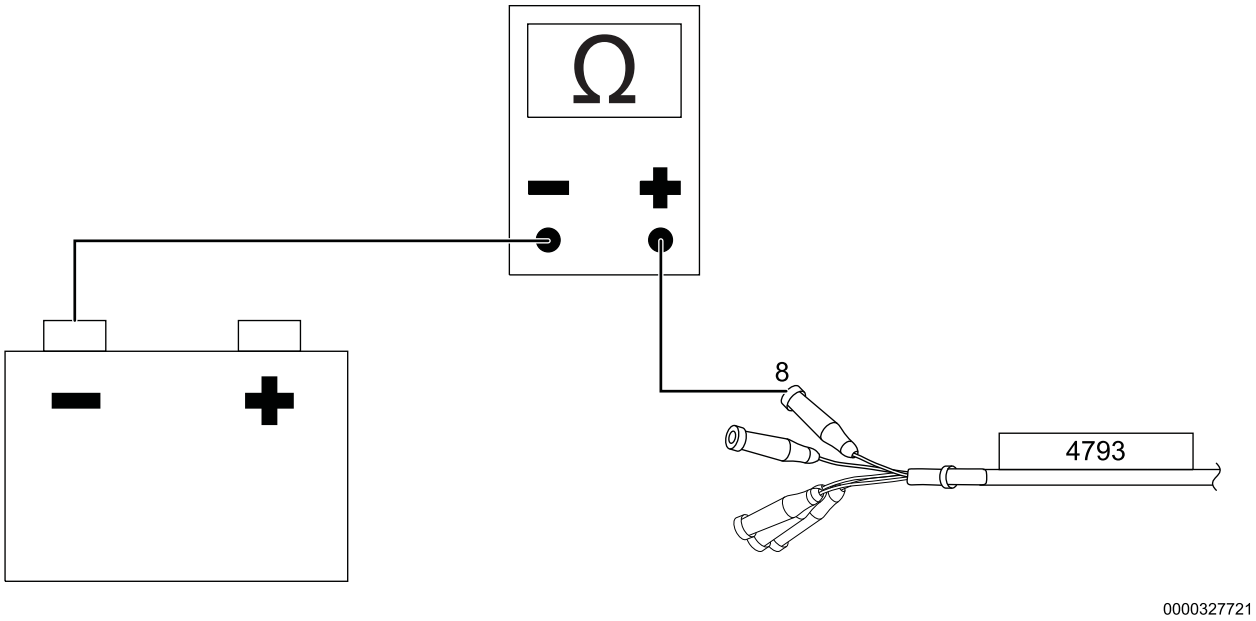
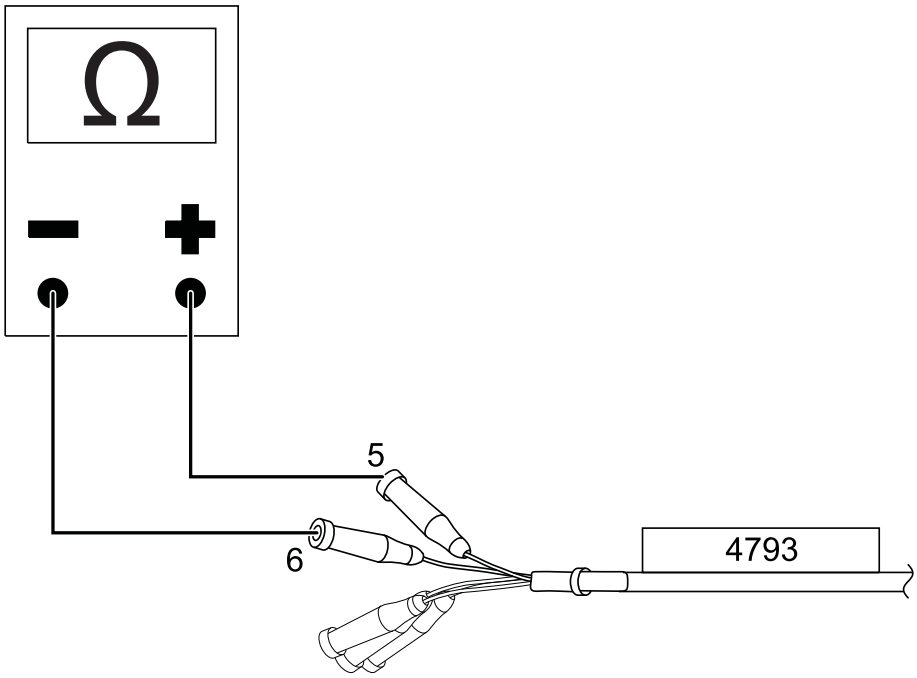


Figure 559 Test 4 Injector 4 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 5.

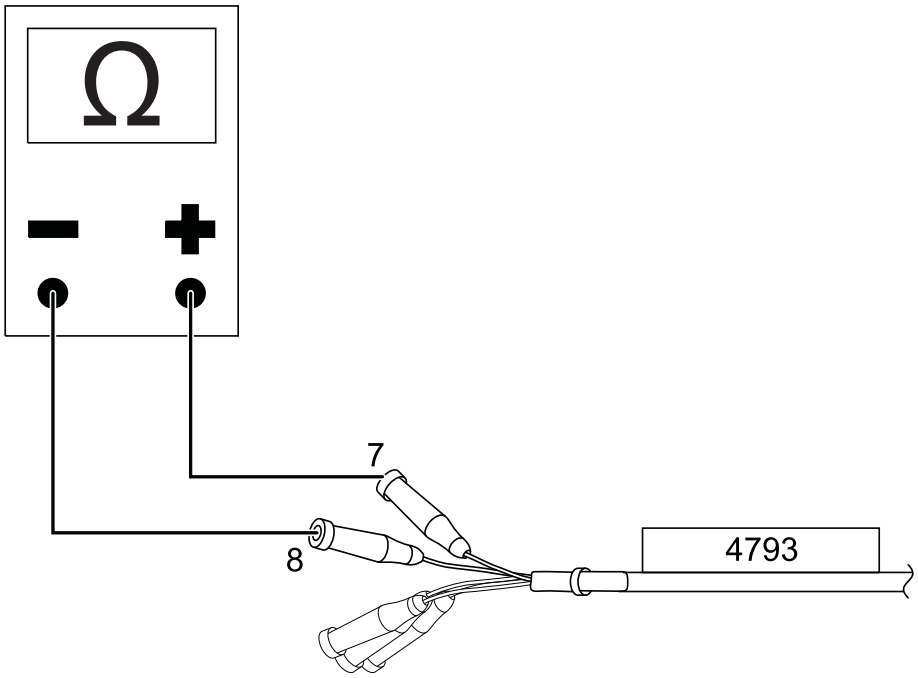


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Figure 560 Test 5 Injector 4 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 6.

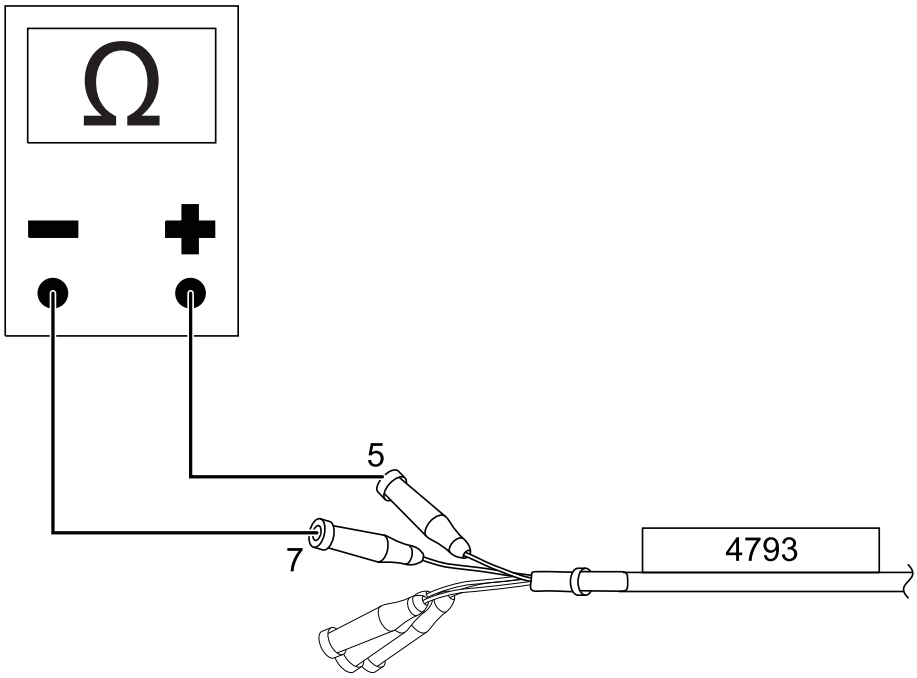


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Figure 561 Test 6 Injector 2 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 7.



0000326281

Figure 562 Test 7 Injector 4 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 3 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 3 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 4 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 4 and leave Injector 4 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 4 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 4 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 4 and leave Injector 4 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 4 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 4 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 4 and leave Injector 4 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 4 pin-3 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 654 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 654 FMI 14 fault code diagnostics.

SPN 655 FMI 14 - Injector 5 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 651 FMI 14 for table		

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 655 FMI 14. Is EST DTC list SPN 655 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 655 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 655 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 655 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 655 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 655 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 655 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10. No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 655 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12. No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8. No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 655 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer. No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 655 FMI 14.

Pin-Point Tests (SPN 655 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

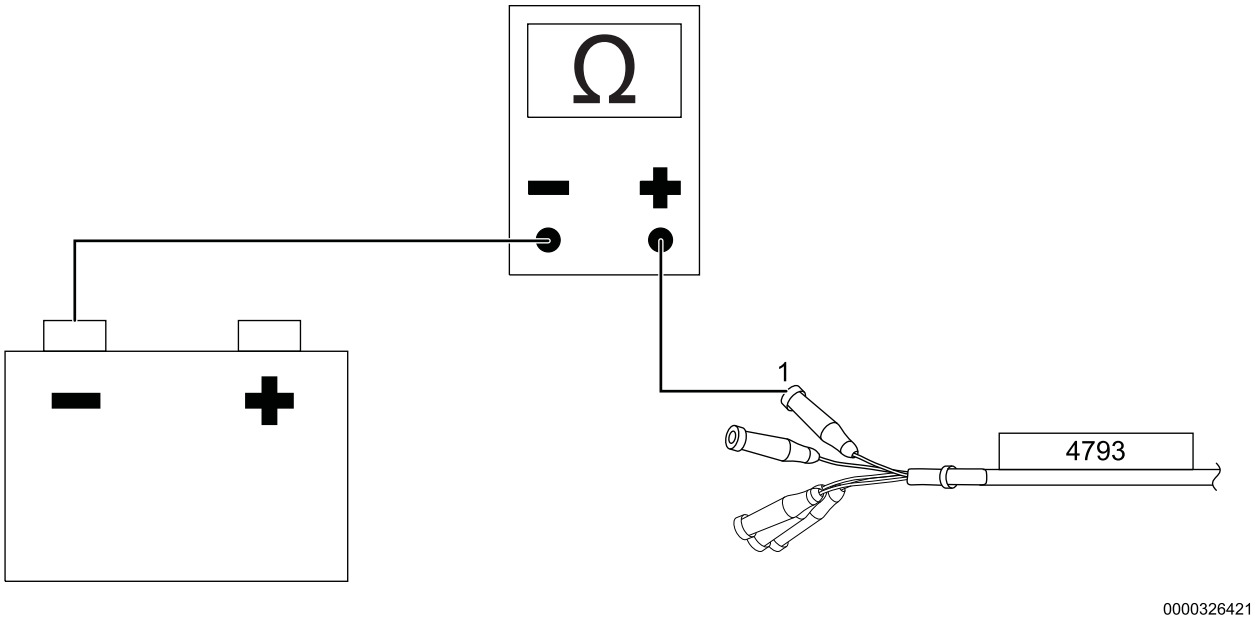


Figure 563 Test 1 Injector 5 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 2.

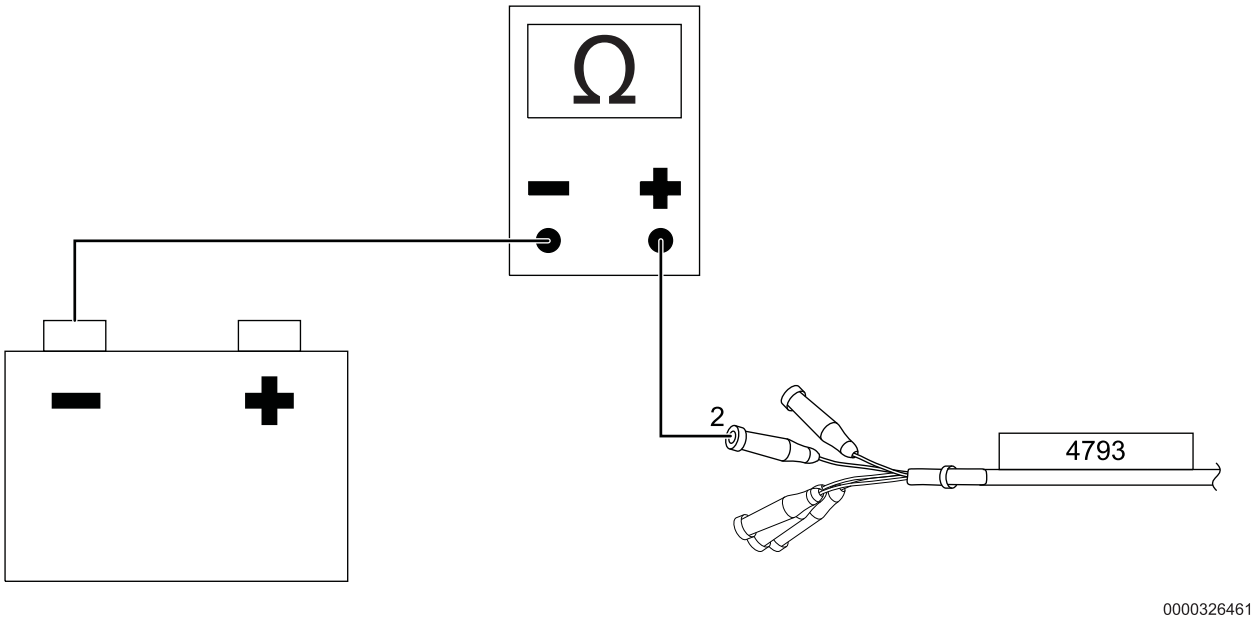


Figure 564 Test 2 Injector 5 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 3.

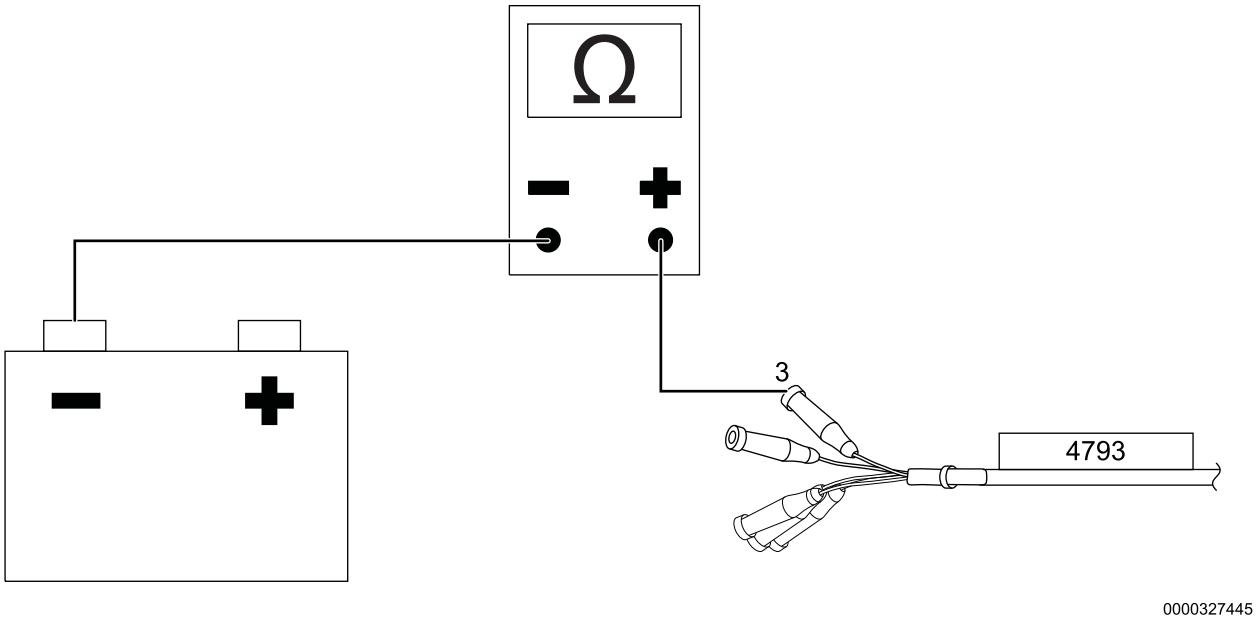


Figure 565 Test 3 Injector 5 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 4.

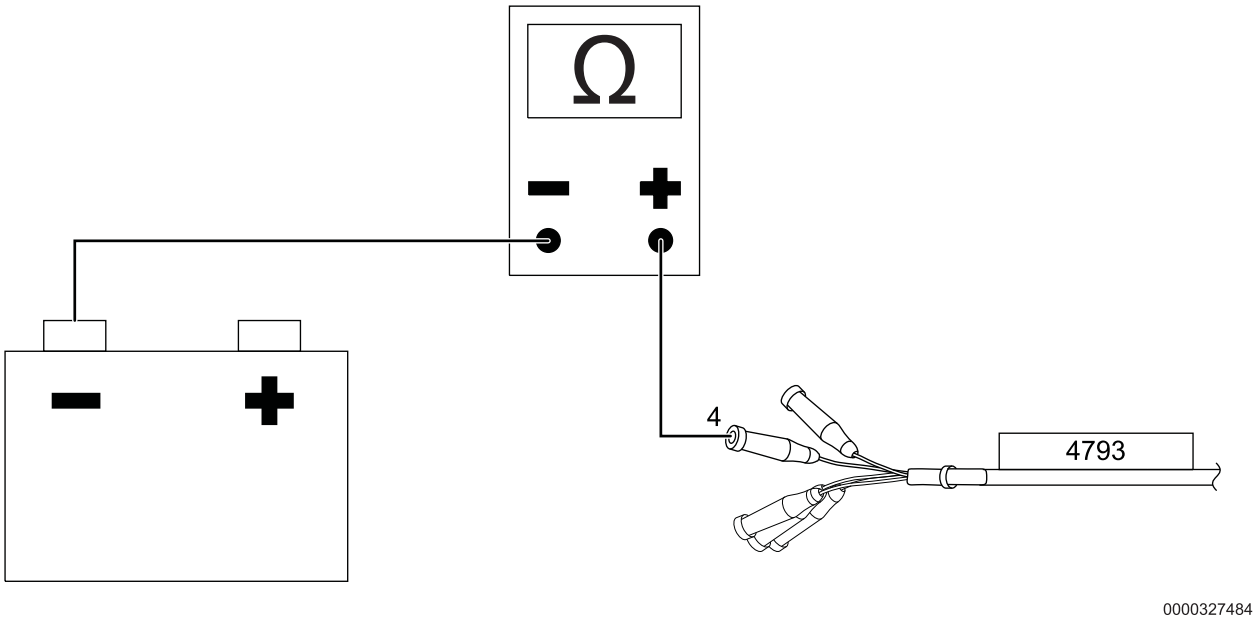
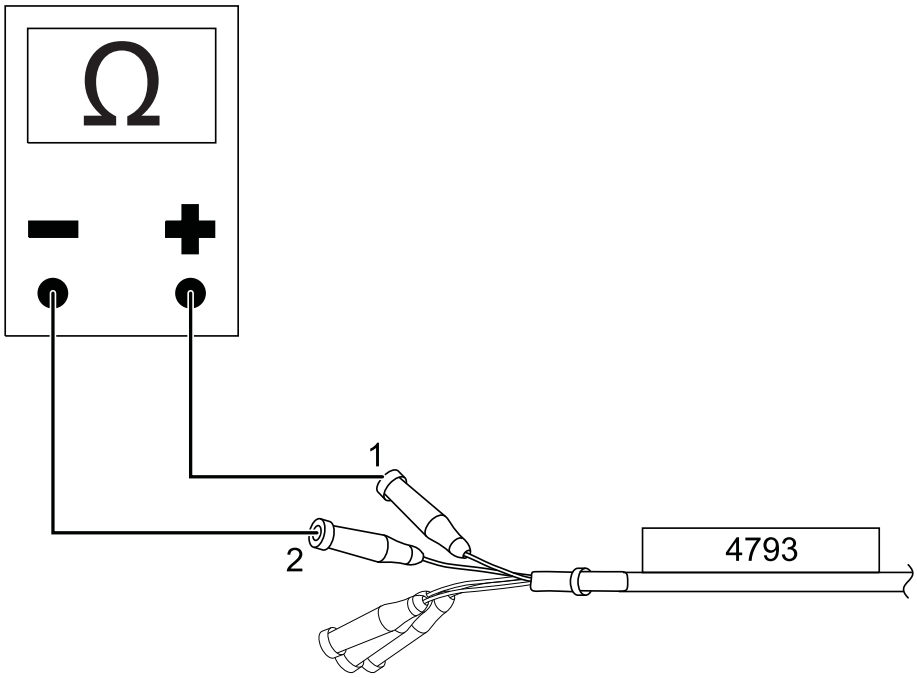


Figure 566 Test 4 Injector 5 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 5.

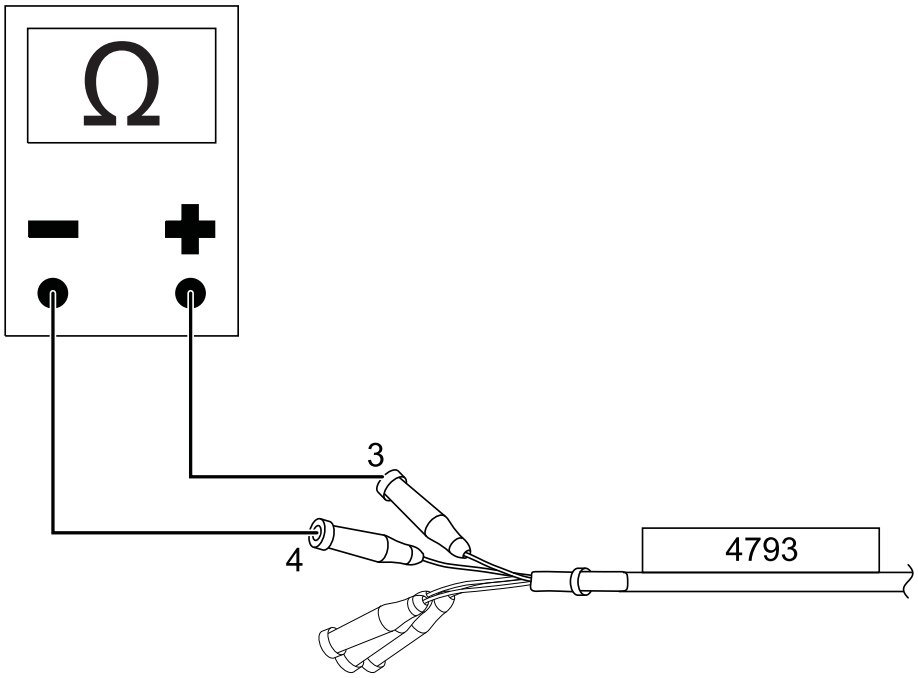


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Figure 567 Test 5 Injector 5 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 6.

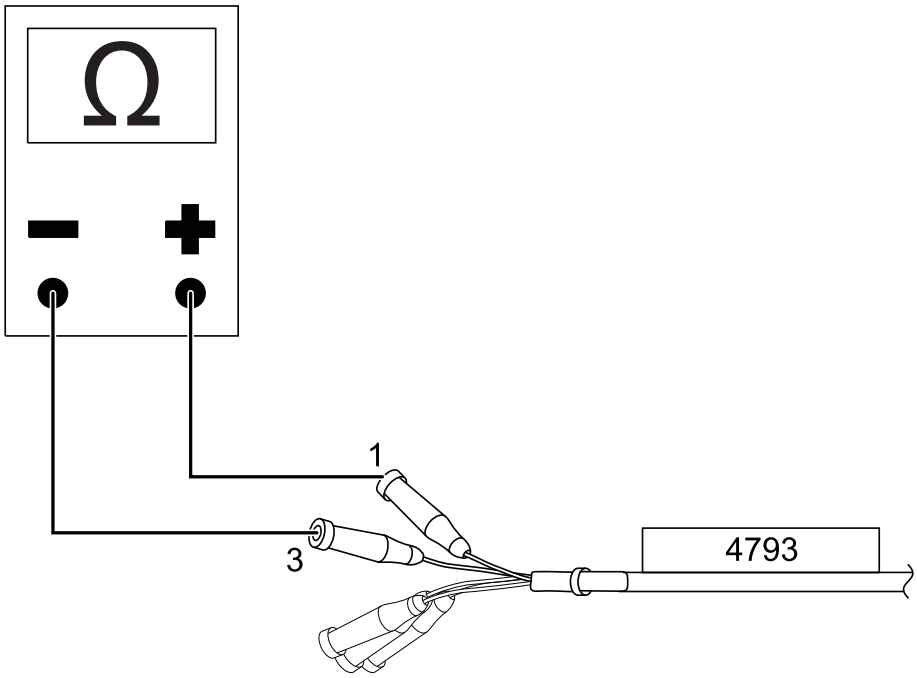


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Figure 568 Test 6 Injector 5 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 7.



0000326241

Figure 569 Test 7 Injector 5 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 5 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 5 and leave Injector 5 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 5 pin-1 and pin-2.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 5 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 5 and leave Injector 5 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 5 pin-3 and pin-4.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 5 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 5 and leave Injector 5 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 5 pin-3 and pin-1.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 655 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 653 FMI 14 fault code diagnostics.

SPN 656 FMI 14 - Injector 6 Fuel quantity/timing error

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
See SPN 651 FMI 14 for table		

Fault Overview

Fault sets when Engine Control Module (ECM) determines injector timing is off when comparing cylinder balance difference between two consecutive cylinders.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Injector fuel or timing deviation
- Spool to control valve body static leakage
- Puck leakage
- Backup ring and / or O-ring leakage at injector inlet
- Injector damage
- Biased Injection Control Pressure (ICP) sensor
- Injector variability
- Engine oil worn out
- Compression loss
- Bent connecting rod
- Aerated oil
- Exhaust Gas Temperature (EGT) sensor drift (biased sensor)

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 656 FMI 14. Is EST DTC list SPN 656 FMI 14 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at injector circuits outside valve cover connector.	Decision
A. Key OFF. B. Disconnect injector circuits outside valve cover connector. C. Check injector circuits outside valve cover and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are injector circuits outside valve cover connector, harness, and terminals clean and undamaged?		Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 656 FMI 14.

Step 3	Test for failed injector.	Decision
Perform KOEO Injector Test(page 2154). Did KOEO Injector Test pass?		Yes: Go to Step 4. No: Go to Test 1.

Step 4	Inspect air intake system, exhaust system, and air filter for restrictions, leaks, or physical damage.	Decision
Inspect air cleaner cleanliness and Mass Air Flow (MAF) sensor or dirt and oil residue. Inspect fuel system from fuel tank to Aftertreatment Fuel Injector (AFT: FI) valve for leaks or physical damage. Are air intake system, exhaust system, fuel system, and air filter free of restrictions, leaks, and physical damage?		Yes: Go to Step 5. No: Repair restrictions, air leaks, fuel leaks, or physical damage. After repairs are complete, retest for SPN 656 FMI 14.

Step 5	Check for fuel level and fuel quality.	Decision
Visually inspect by removing fuel cap from all tanks, check Water In Fuel (WIF) light, and sample for dirty or aerated fuel. Is there sufficient supply of good quality fuel?		Yes: Go to Step 6. No: Remove dirty or aerated fuel, fill with good quality fuel. After repairs are complete, retest for SPN 656 FMI 14.

Step 6		Decision
Check for oil and oil quality, including oil level check and aerated oil. Is there sufficient supply of clean, non-aerated oil?		Yes: Go to Step 7. No: Remove dirty, aerated, or contaminated oil, fill with clean, non-aerated oil. After repairs are complete, retest for SPN 656 FMI 14.

Step 7	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, do KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 8. No: Replace ECB valve. After repairs are complete, retest for SPN 656 FMI 14.

Step 8	Determine if Engine Compression Brake (ECB), if equipped, is operating correctly.	Decision
Using EST with ServiceMaxx™ software, perform KOEO Low to High Idle Test(page 2140) while monitoring Brake Control Pressure (ECBP). Is ECBP within specification(page 2402)?		Yes: Go to Step 9. No: Replace ECB valve. After repairs are complete, retest for SPN 656 FMI 14.

Step 9	Calibrate MAF sensor.	Decision
Perform KOER MAF Sensor Calibrations(page 2268). Did MAF auto-calibrated succeed?		Yes: Go to Step 10. No: Perform test and procedures for a malfunctioning MAF sensor. After repairs are complete, retest for SPN 656 FMI 14.

Step 10	Determine cause of rough engine idle.	Decision
Perform KOEO Relative Compression Test(page 2167). Are all engine cylinder performance readings similar?		Yes: Go to Step 12. No: Go to Step 11.

Step 11	Test cylinder performance further.	Decision
Do Cylinder Performance Analyzer (CPA) test to evaluate cylinder performance issues. Evaluate performance concerns during cold idle(page 2201), hot idle(page 2212), and a full load highway speed test(page 2217). Due to the complexity of some of the codes, print out the CPA tool results for later use. Did tests finish without identifying a suspect cylinder?		Yes: Go to Step 8. No: Remove valve cover, check valve lash, and crank engine to verify cam shaft lobe operation and lift (See *Engine Service Manual*). After repairs are complete, retest for SPN 656 FMI 14.

Step 12	Test for oil leaks under the valve cover.	Decision
Using Leak Detection Pump Tool, test for oil leaking from or around ECB valve, center of oil rail to cylinder head, injector oil inlet adapters (puck), and ICP sensor. Some leakage around injector spool valves is normal. Are the listed items leak-free?		Yes: Return vehicle to customer. No: Remove rail and replace any of the following as required: ECB valve, center of oil rail to cylinder head O-ring, leaking injector oil inlet adapter, and/or ICP sensor. After repairs

	are complete, retest for SPN 656 FMI 14.

Pin-Point Tests (SPN 656 FMI 14)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

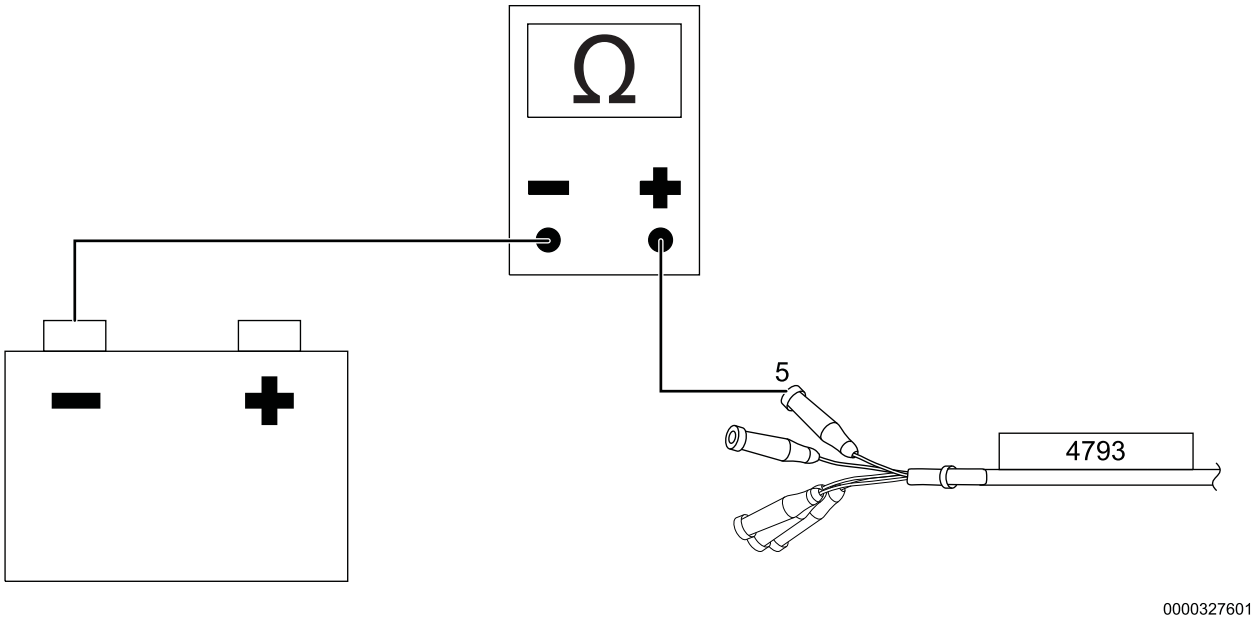


Figure 570 Test 1 Injector 6 Circuit Resistance Through Valve Cover Check

Test 1 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 2.

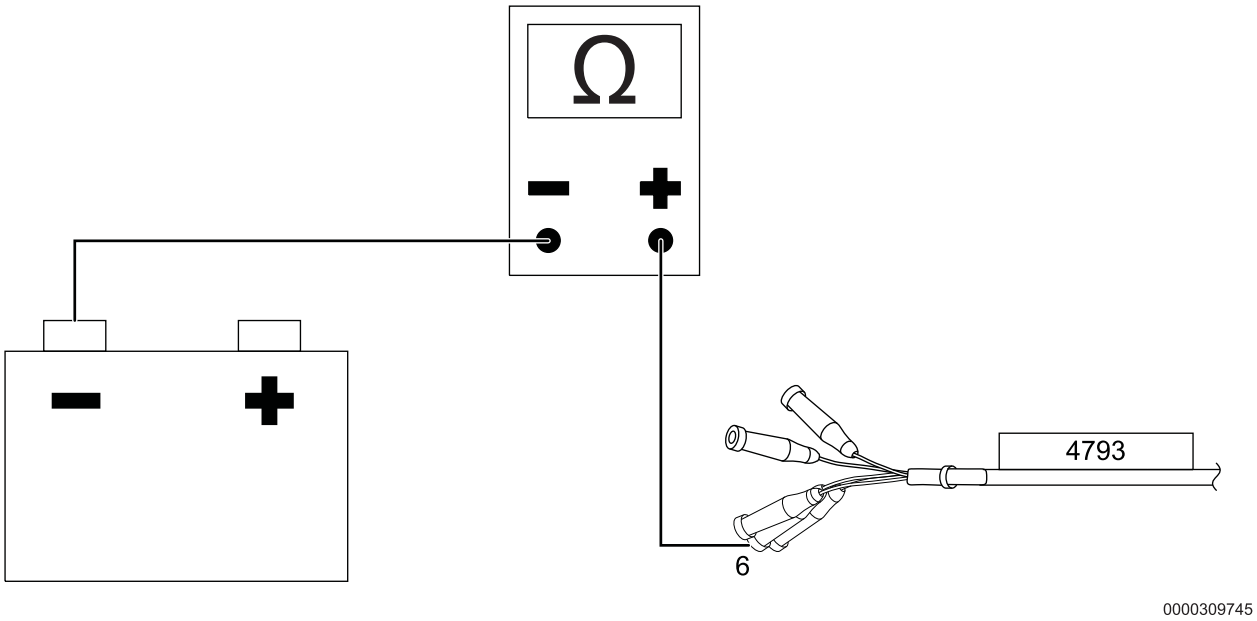


Figure 571 Test 2 Injector 6 Circuit Resistance Through Valve Cover Check

Test 2 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 3.

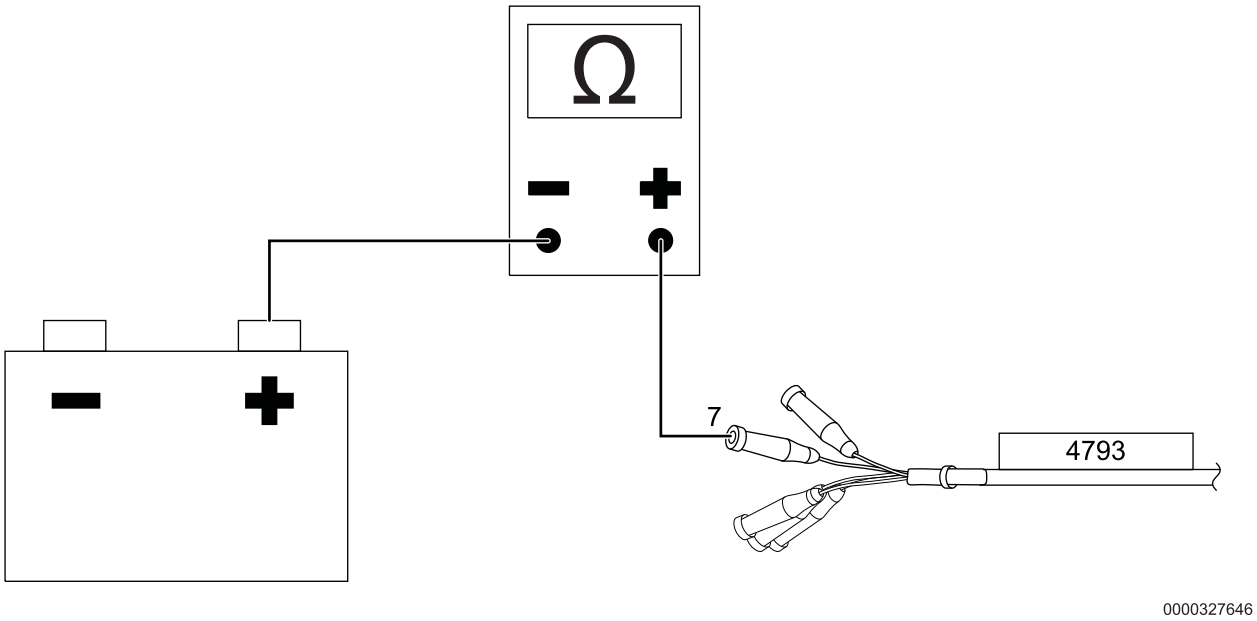


Figure 572 Test 3 Injector 6 Circuit Resistance Through Valve Cover Check

Test 3 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 3	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 4.

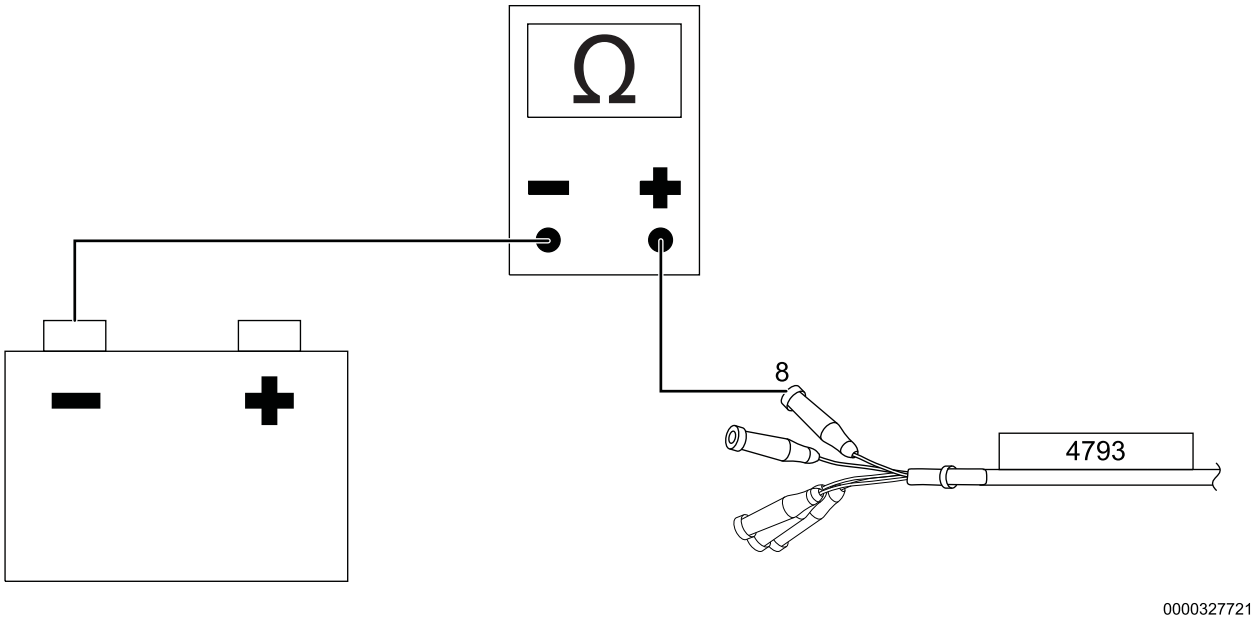
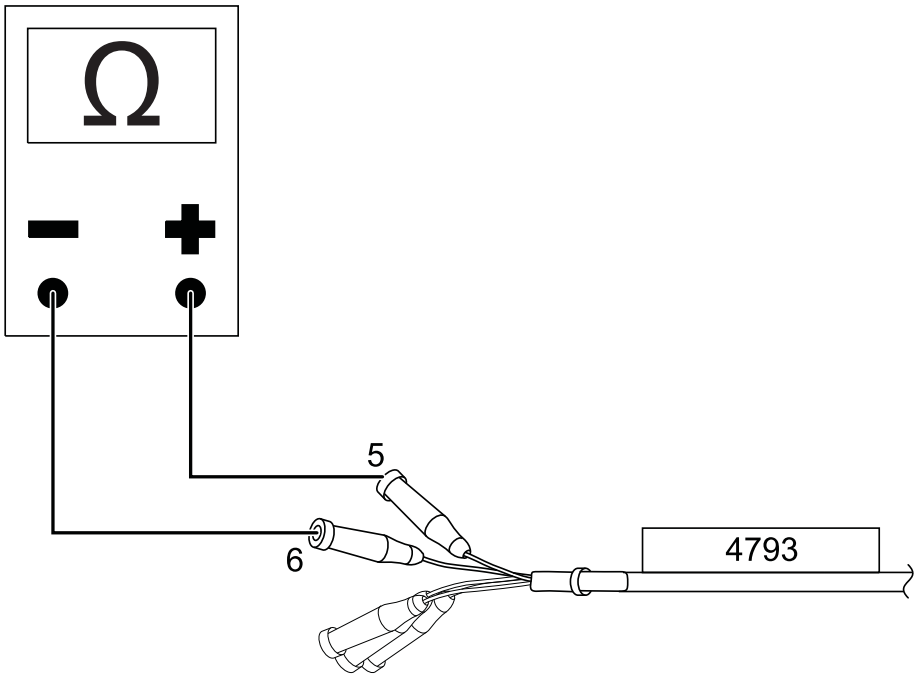


Figure 573 Test 4 Injector 6 Circuit Resistance Through Valve Cover Check

Test 4 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 4	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check circuit for short to GND or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 5.

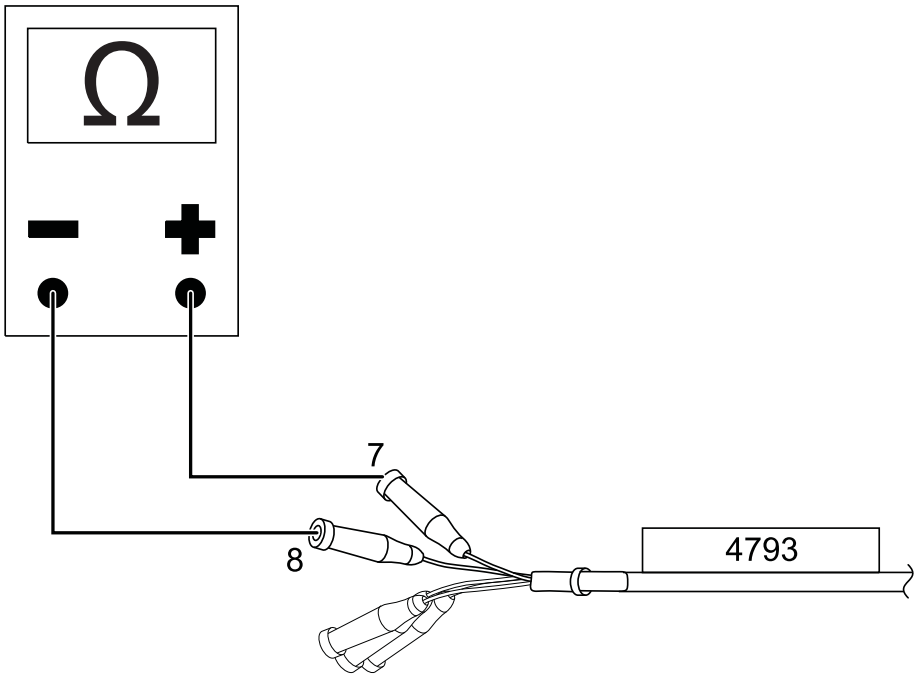


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Figure 574 Test 5 Injector 6 Coil Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 5	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 6.

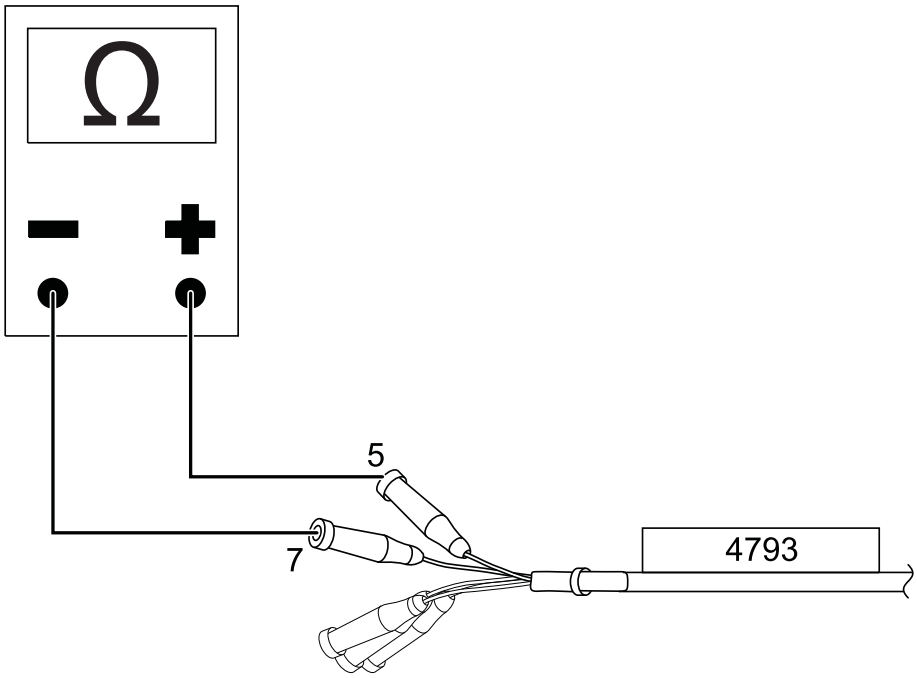


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Figure 575 Test 6 Injector 6 Coil Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 6	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 7.



0000326281

Figure 576 Test 7 Injector 6 Coil Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect 8-Pin UVC 4 connector. C. Connect Breakout Harness ZTSE4793 to vehicle harness connector and leave UVC 4 disconnected. D. Key ON.

Test 7	Specification
Using DMM to measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 8.

Test 8 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 6 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 6 and leave Injector 6 UVC harness disconnected. E. Key ON.

Test 8	Specification
Using DMM to measure resistance between Injector 6 pin-5 and pin-6.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 9.

Test 9 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 6 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 6 and leave Injector 6 UVC harness disconnected. E. Key ON.

Test 9	Specification
Using DMM to measure resistance between Injector 6 pin-7 and pin-8.	1.0 ± 0.5 ohms
Decision	
Is resistance greater than 1.5 ohms?	Yes: Check for OPEN through injector. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Test 10.

Test 10 Setup
A. Key OFF. B. Remove Valve Cover. C. Disconnect harness from Injector 6 under valve cover. D. Using Terminal Test Kit ZTSE4435C connect Injector 6 and leave Injector 6 UVC harness disconnected. E. Key ON.

Test 10	Specification
Using DMM to measure resistance between Injector 6 pin-3 and pin-7.	Greater than 1 kiloohms
Decision	
Is resistance less than 1 kiloohms?	Yes: Check for cross-shorted circuits or injector coil for internal short. After repairs are complete, retest for SPN 656 FMI 14.
	No: Go to Step 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 656 FMI 14 fault code diagnostics.

SPN 2797 FMI 6 - Injector Control Group 1 - short circuit (INJ 1, 2, 3)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on Bank 0 Open coil {Bank 0: Injector Number 1, 2, and 3} Short circuit detection on Bank 0 Close coil {Bank 0: Injector Number 1, 2, and 3}	Driver indicates short circuit on Open coil. Current detected by driver > 50 Amps Driver indicates short circuit on Close coil. Current detected by driver > 50 Amps	Key ON, Engine Running Battery voltage > 9 Volts Injectors firing

Fault Overview

Fault code sets when short circuit is detected on Bank 0 (Injectors 1, 2, and 3) Open or Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 651-653 FMI 4 and 5 (INJ)	• SPN 3659-3661 FMI 4 and 5 (INJ)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel injector 1 Open circuit short to GND
- Fuel injector 1 Close circuit short to GND
- Fuel injector 1 Open circuit short to PWR
- Fuel injector 1 Close circuit short to PWR
- Fuel Injector 1 Open H shorted to Open L
- Fuel Injector 1 Close H shorted to Close L
- Fuel Injector 1 Close circuit shorted to Open circuit
- Failed Fuel Injector 1
- Fuel injector 2 Open circuit short to GND
- Fuel injector 2 Close circuit short to GND

- Fuel injector 2 Open circuit short to PWR
- Fuel injector 2 Close circuit short to PWR
- Fuel Injector 2 Open H shorted to Open L
- Fuel Injector 2 Close H shorted to Close L
- Fuel Injector 2 Close circuit shorted to Open circuit
- Failed Fuel Injector 2
- Fuel injector 3 Open circuit short to GND
- Fuel injector 3 Close circuit short to GND
- Fuel injector 3 Open circuit short to PWR
- Fuel injector 3 Close circuit short to PWR
- Fuel Injector 3 Open H shorted to Open L
- Fuel Injector 3 Close H shorted to Close L
- Fuel Injector 3 Close circuit shorted to Open circuit
- Failed Fuel Injector 3

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1565). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2797 FMI 6.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 2797 FMI 6. Is EST DTC list SPN 2797 FMI 6 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2797 FMI 6.

Step 4	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3 C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are

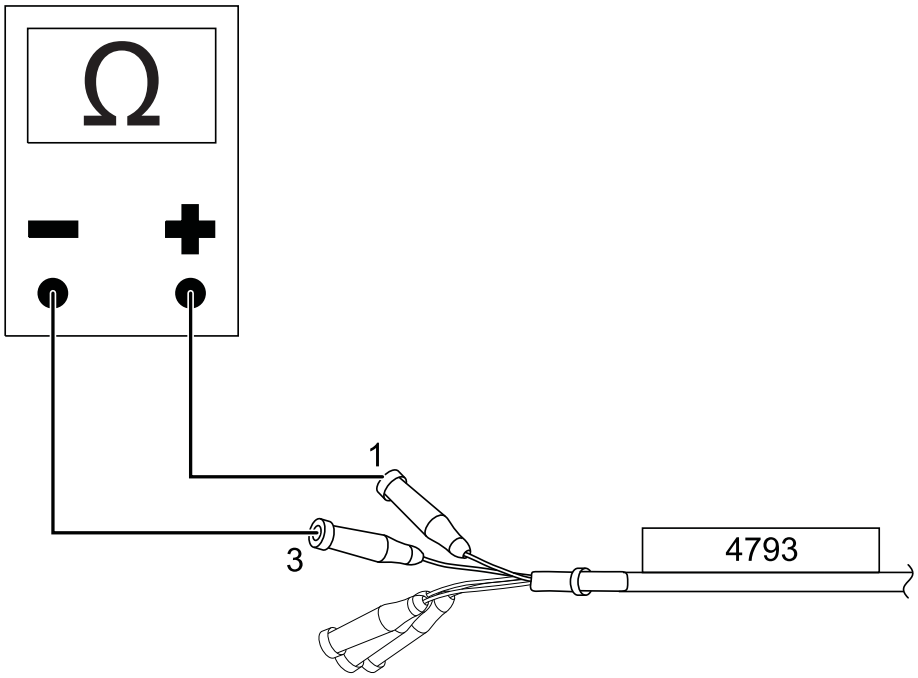
	complete, retest for SPN 2797 FMI 6.

Pin-Point Tests (SPN 2797 FMI 6)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

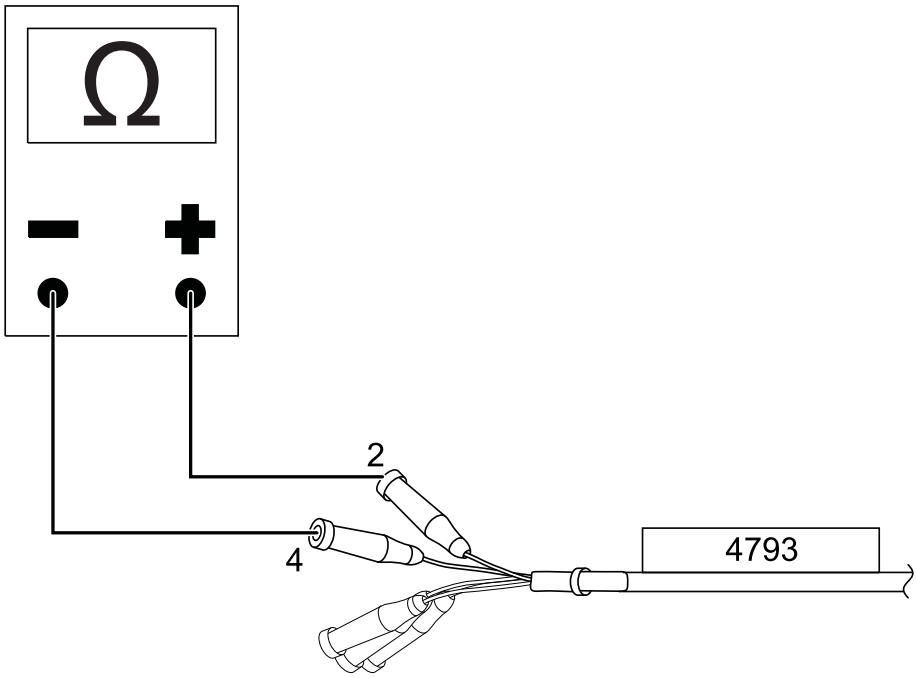


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Figure 577 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

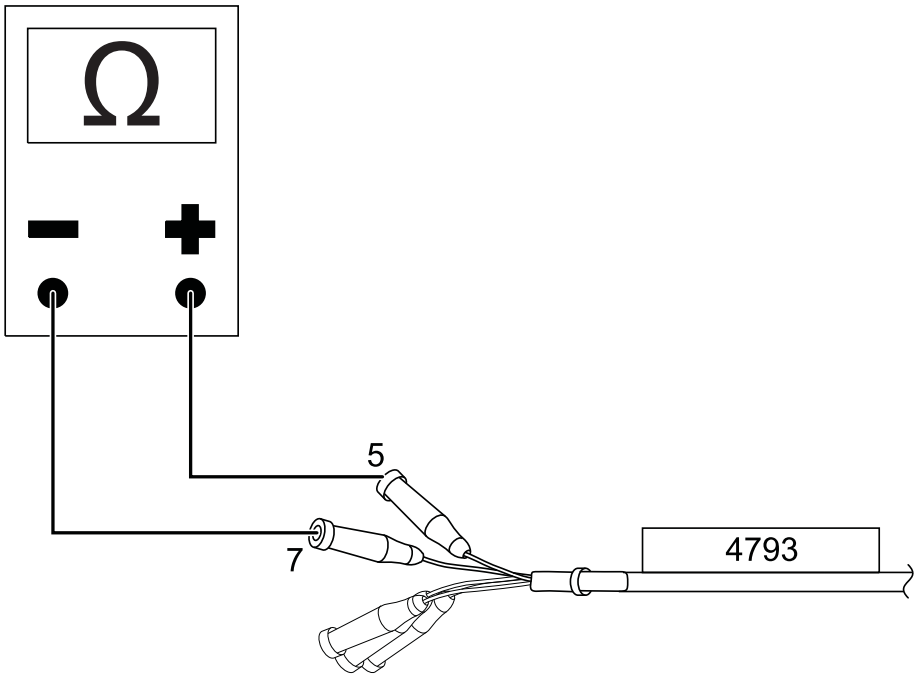


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Figure 578 Test 2 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

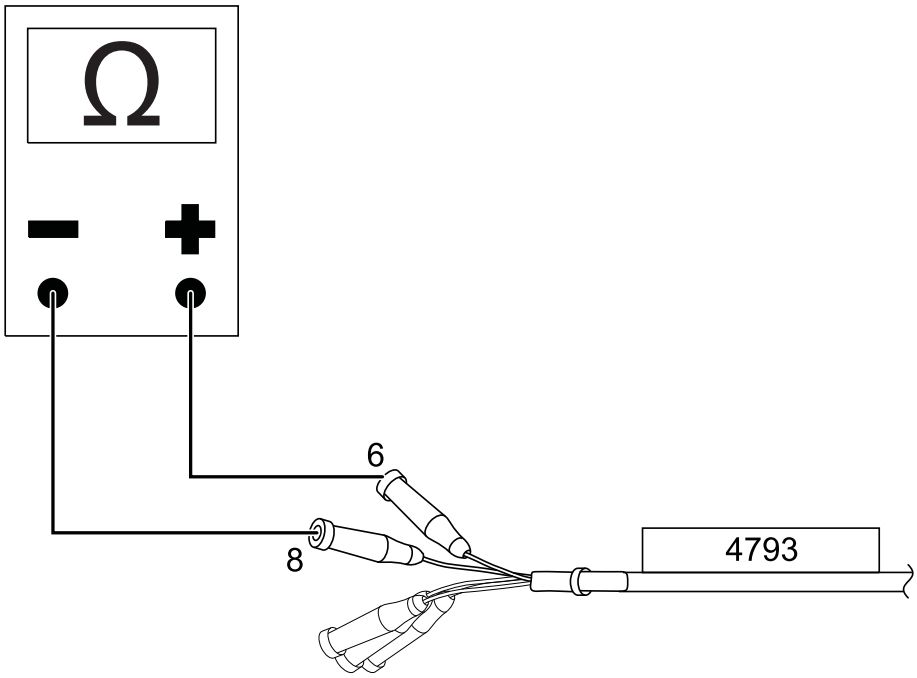


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Figure 579 Test 3 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 4.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

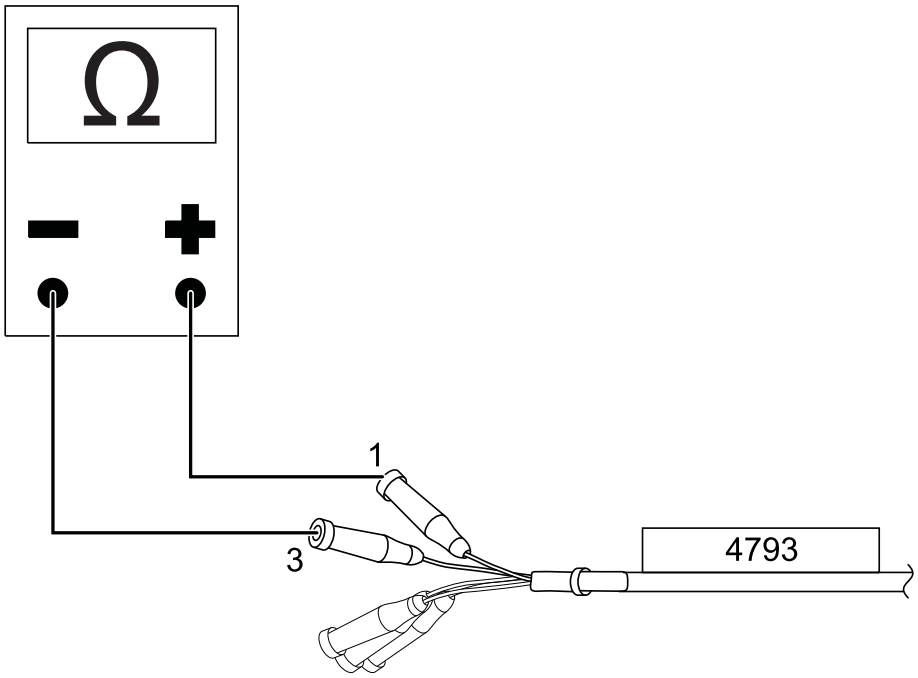


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Figure 580 Test 4 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

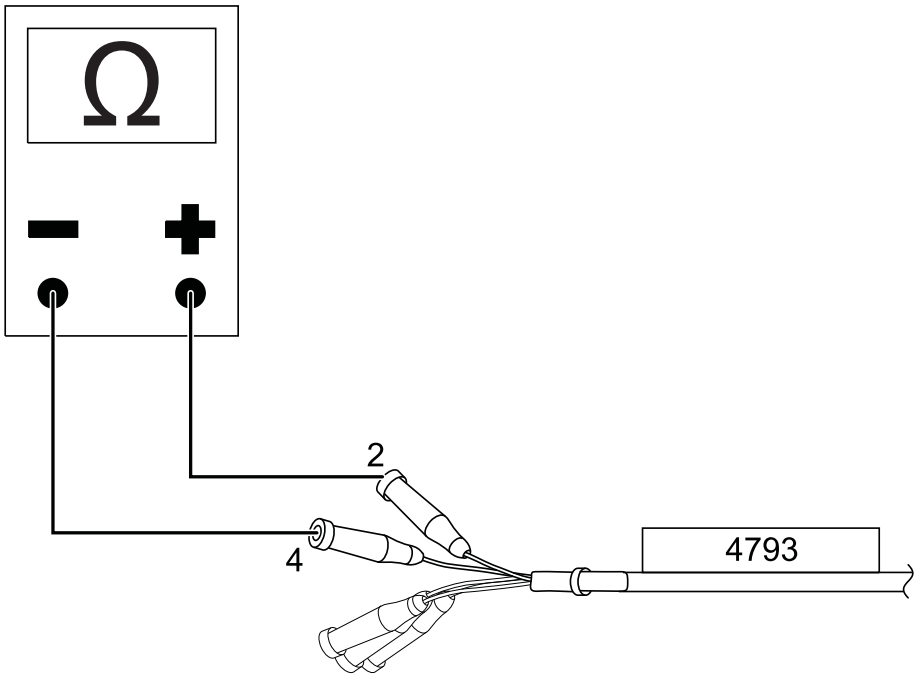


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Figure 581 Test 5 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

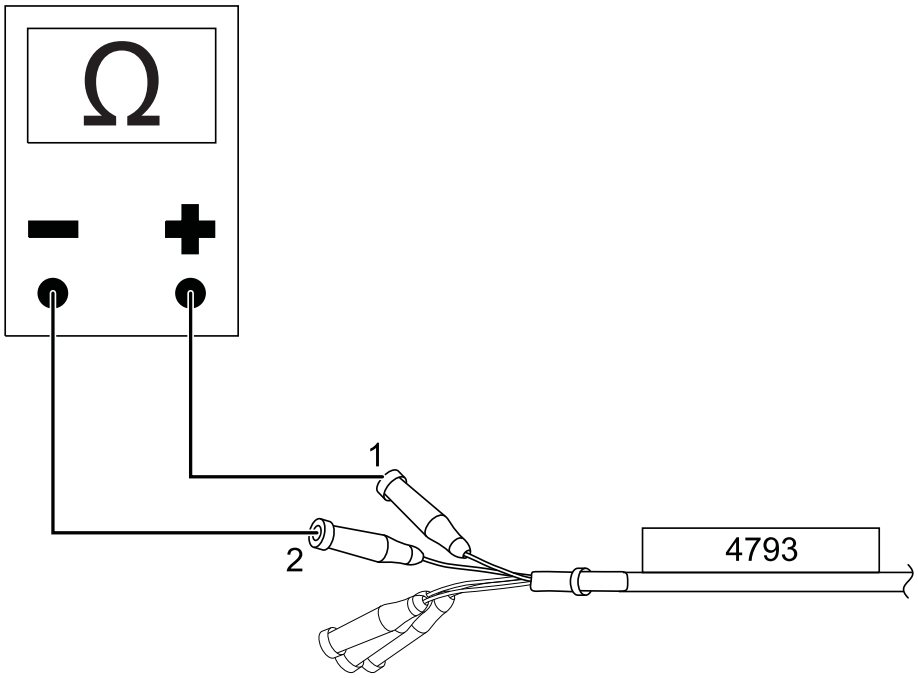


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Figure 582 Test 6 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 7.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2797 FMI 6

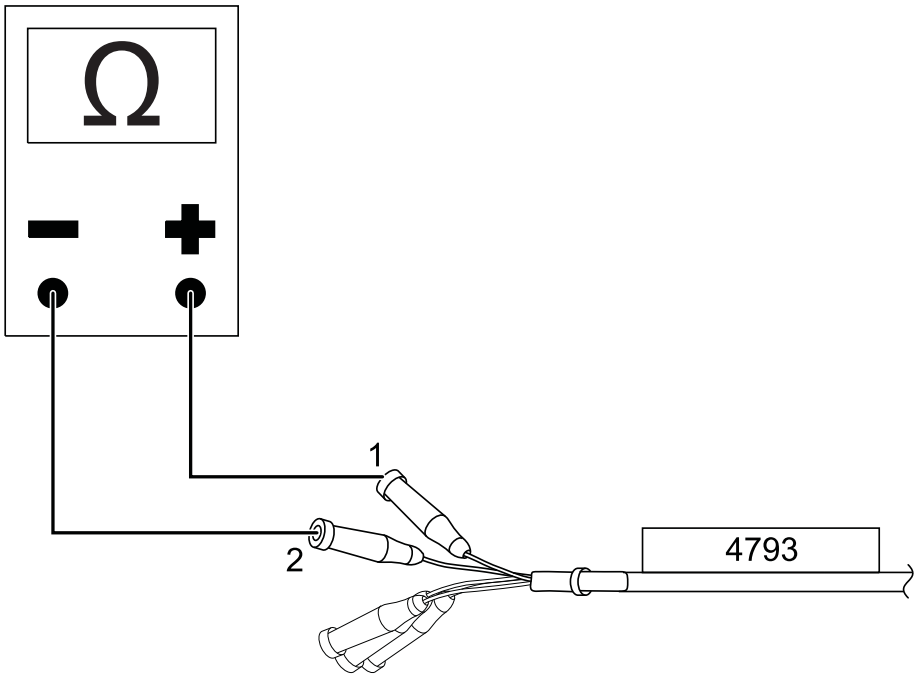


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Figure 583 Test 7 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 7	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 8.
	No: Go to Test 9.

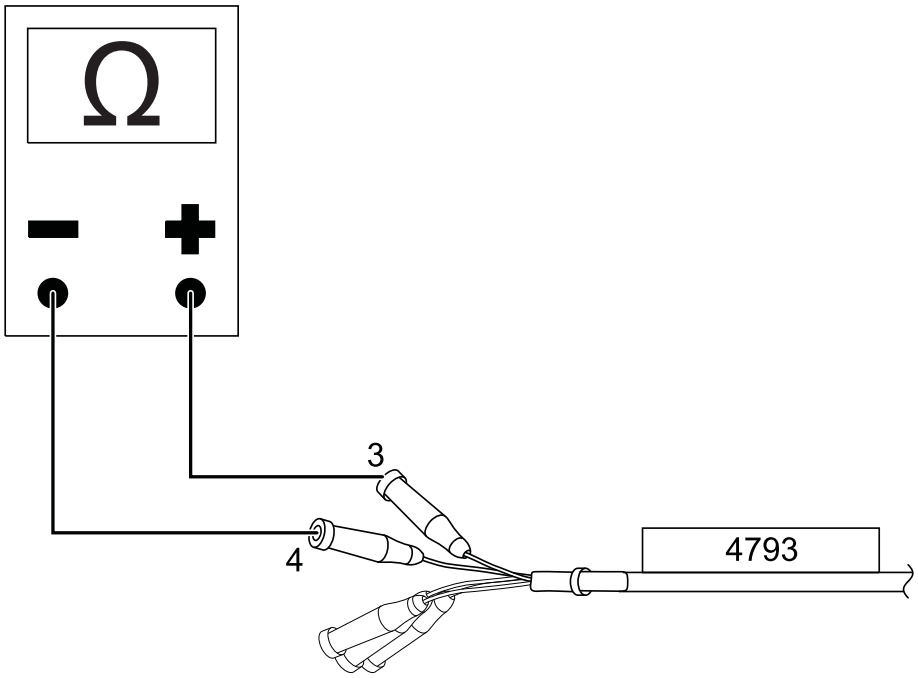


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Figure 584 Test 8 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 8 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 8	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 1 Close coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 2797 FMI 6.

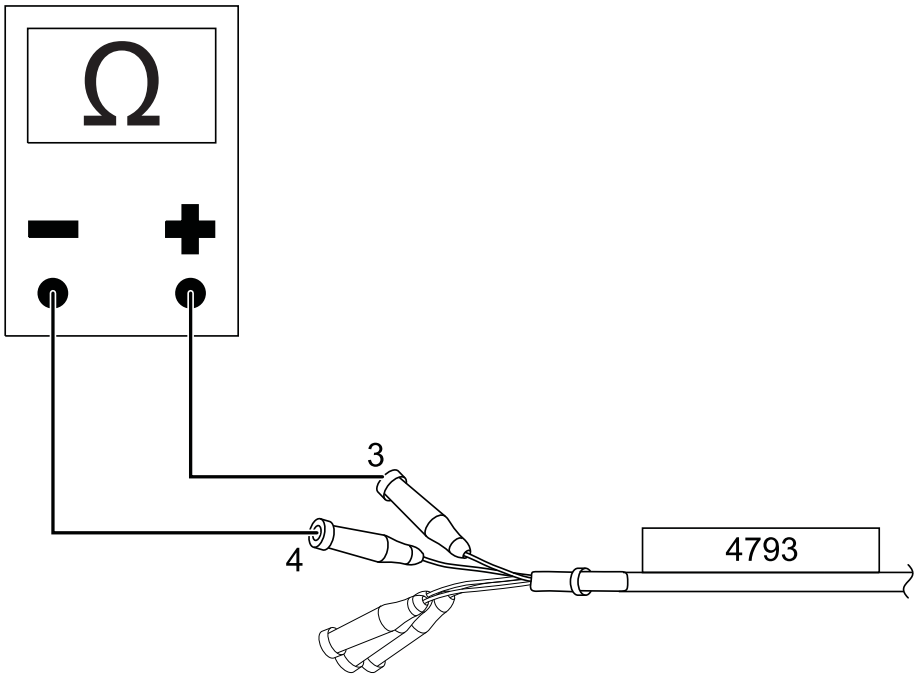


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Figure 585 Test 9 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 9 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 9	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 10.
	No: Go to Test 11.

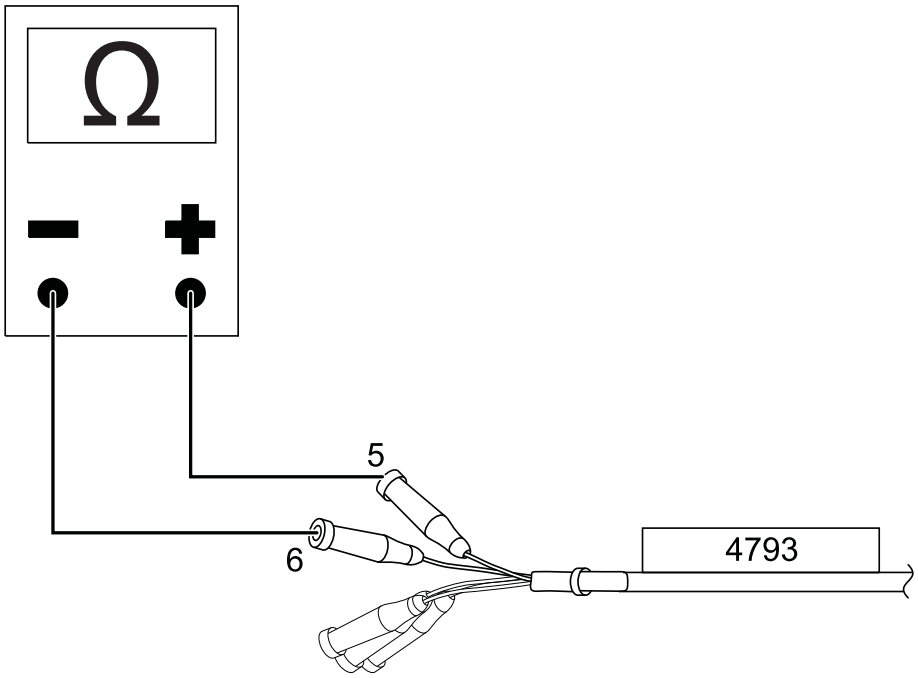


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Figure 586 Test 10 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 10 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 10	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 1 Open coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 2797 FMI 6.

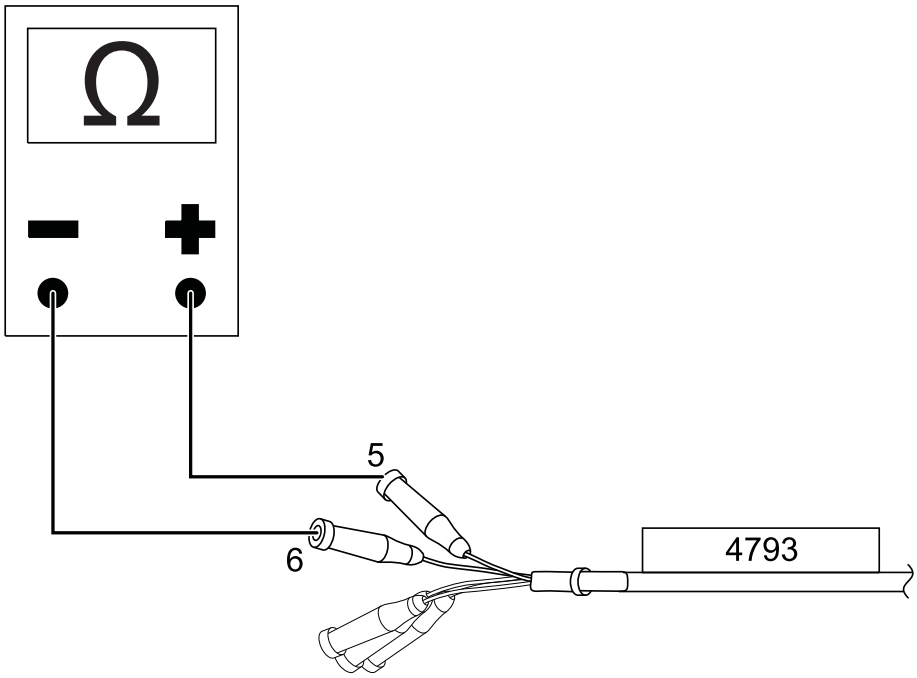


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Figure 587 Test 11 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 11 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 11	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 12.
	No: Go to Test 13.

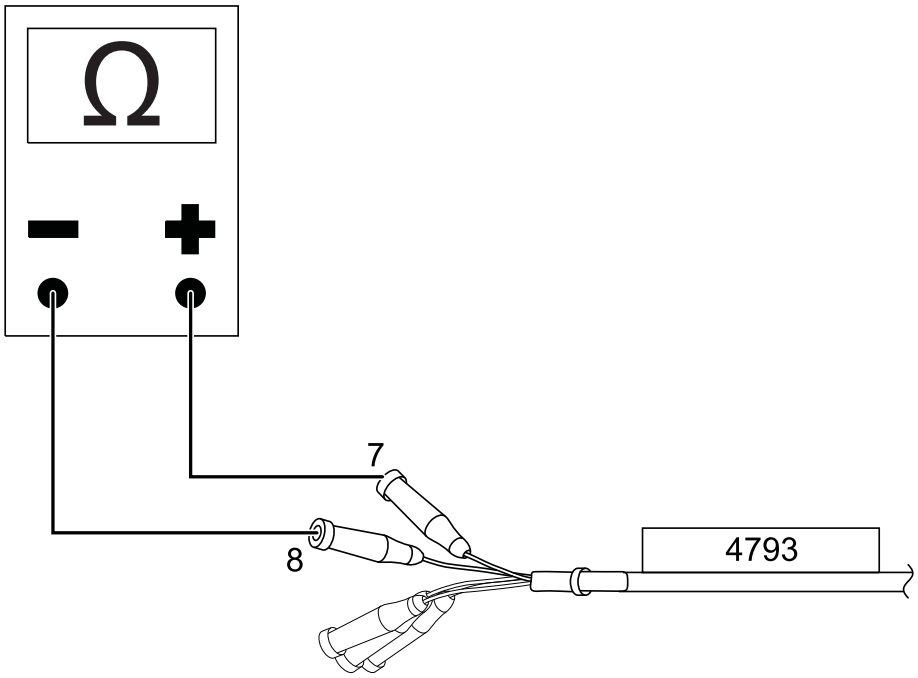


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Figure 588 Test 12 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 12 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 12	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 2 Close coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 2797 FMI 6.

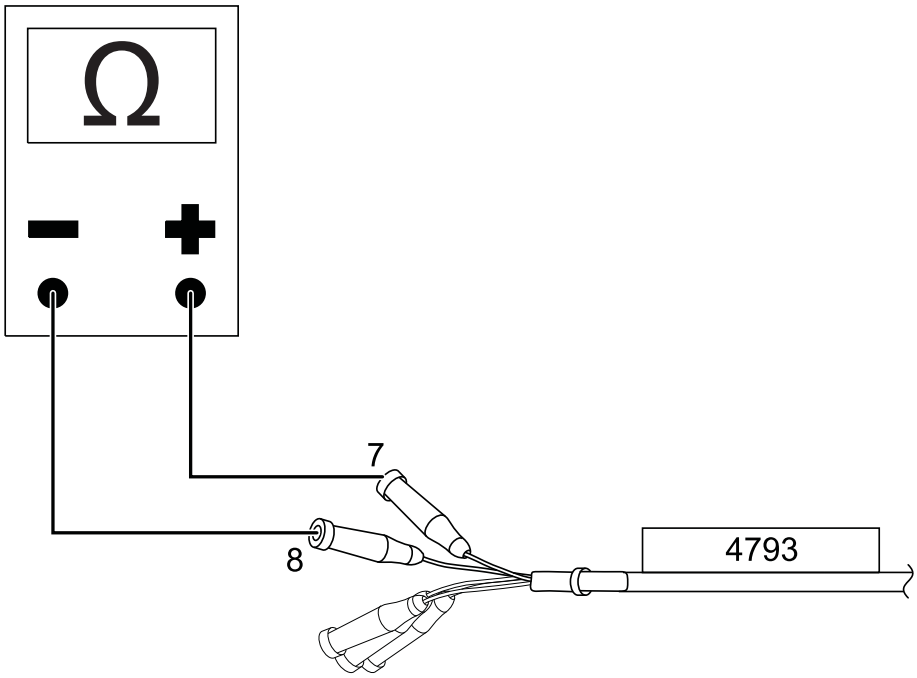


0000326401

Figure 589 Test 13 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 13 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 13	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 14.
	No: Go to Test 15.

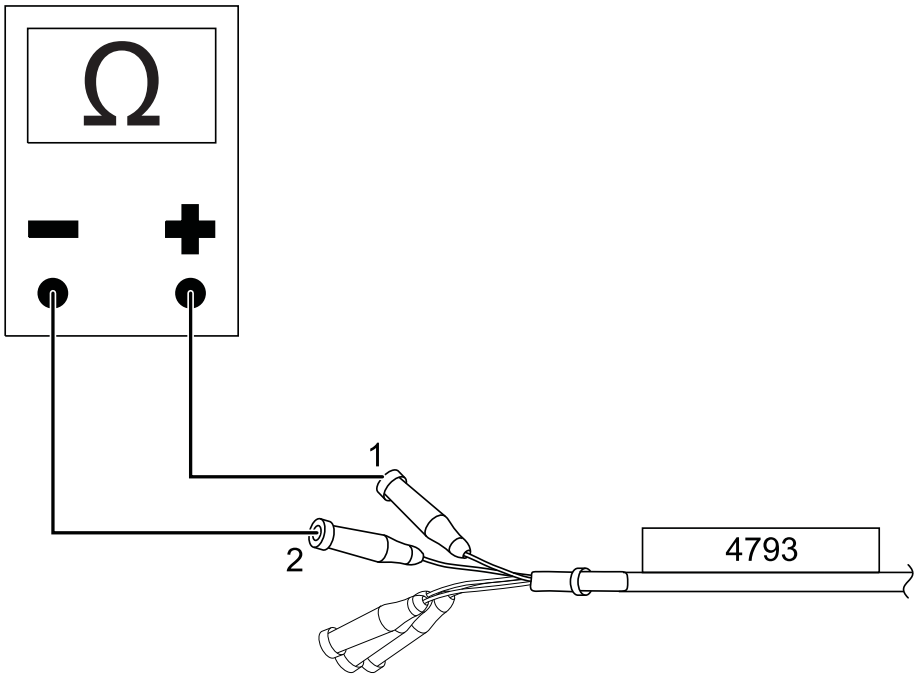


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Figure 590 Test 14 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 14 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 14	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 2 Open coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 2797 FMI 6.

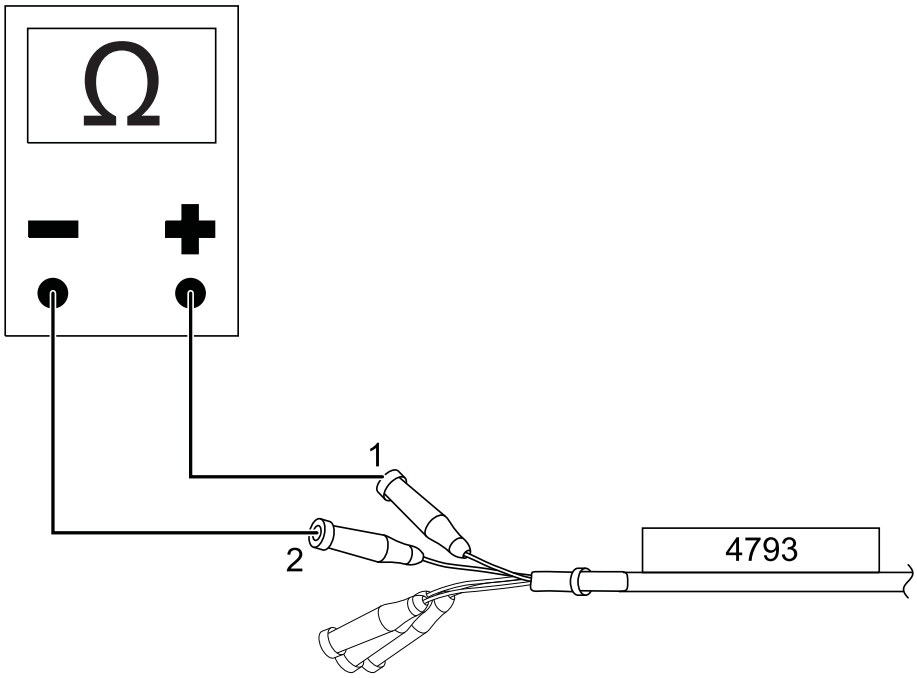


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Figure 591 Test 15 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 15 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 15	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 16.
	No: Go to Test 17.

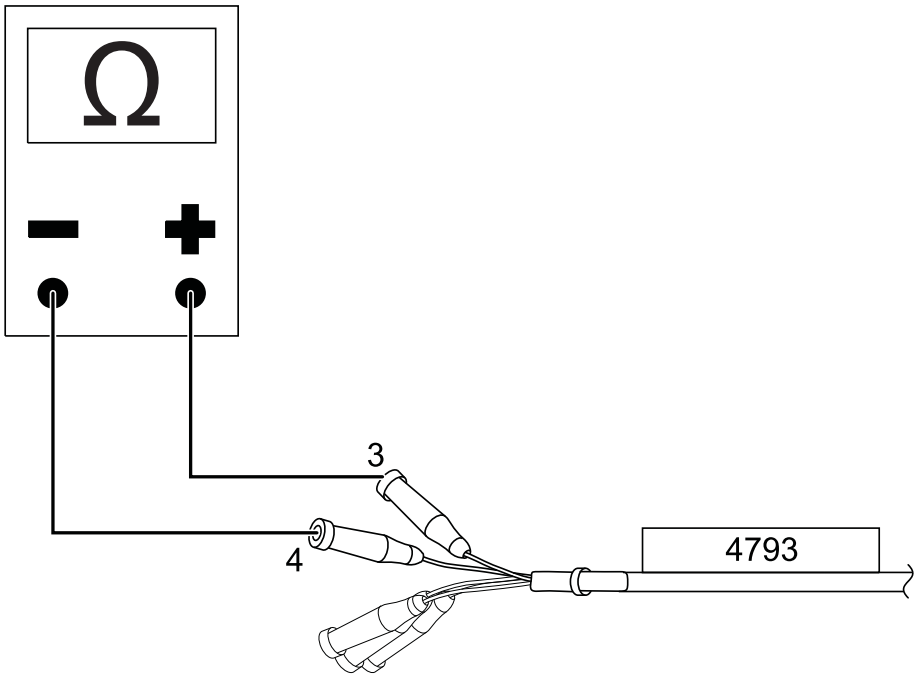


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Figure 592 Test 16 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 16 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 16	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 3 Close coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 2797 FMI 6.

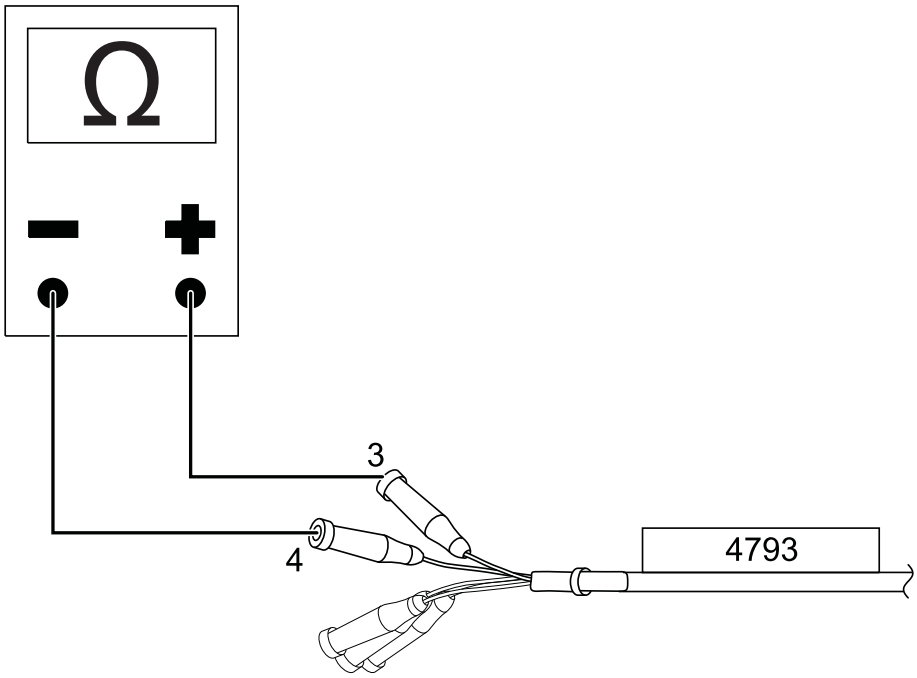


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Figure 593 Test 17 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 17 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 17	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 18.
	No: Go to Test 19.



0000326361

Figure 594 Test 18 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 18 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 18	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 3 Open coil circuit. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 2797 FMI 6.

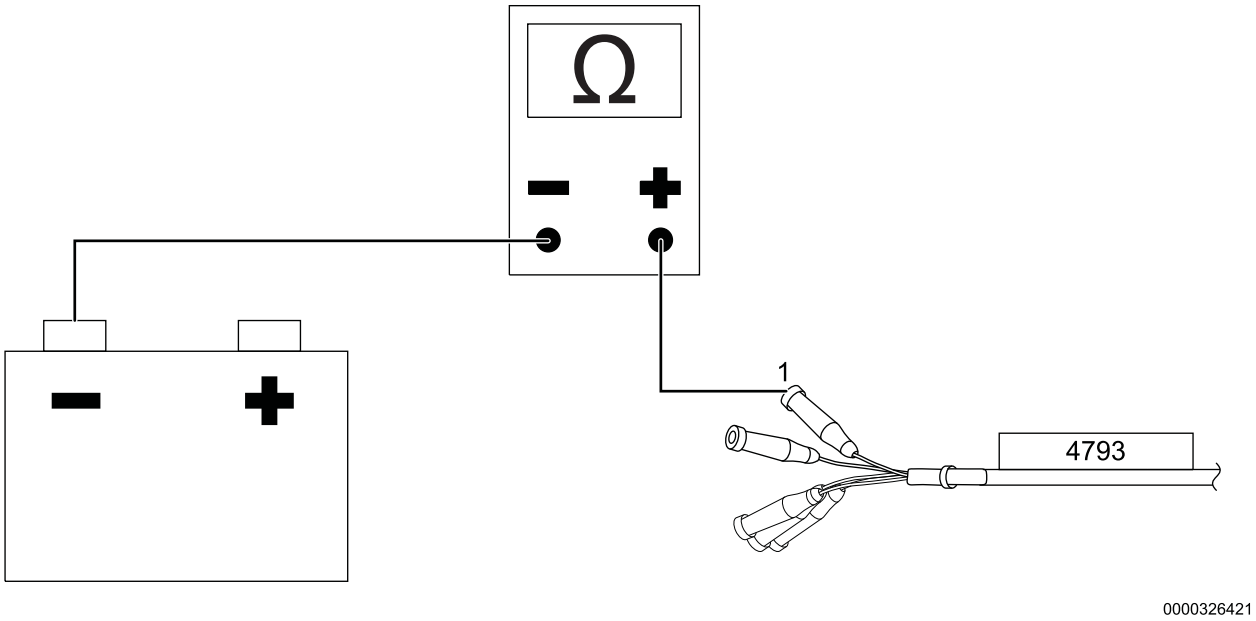


Figure 595 Test 19 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 19 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 19	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 20.
	No: Repair short to GND between Injector 1 pin-1 and ECM Driver pin D-8. After repairs are complete, retest for SPN 2797 FMI 6.

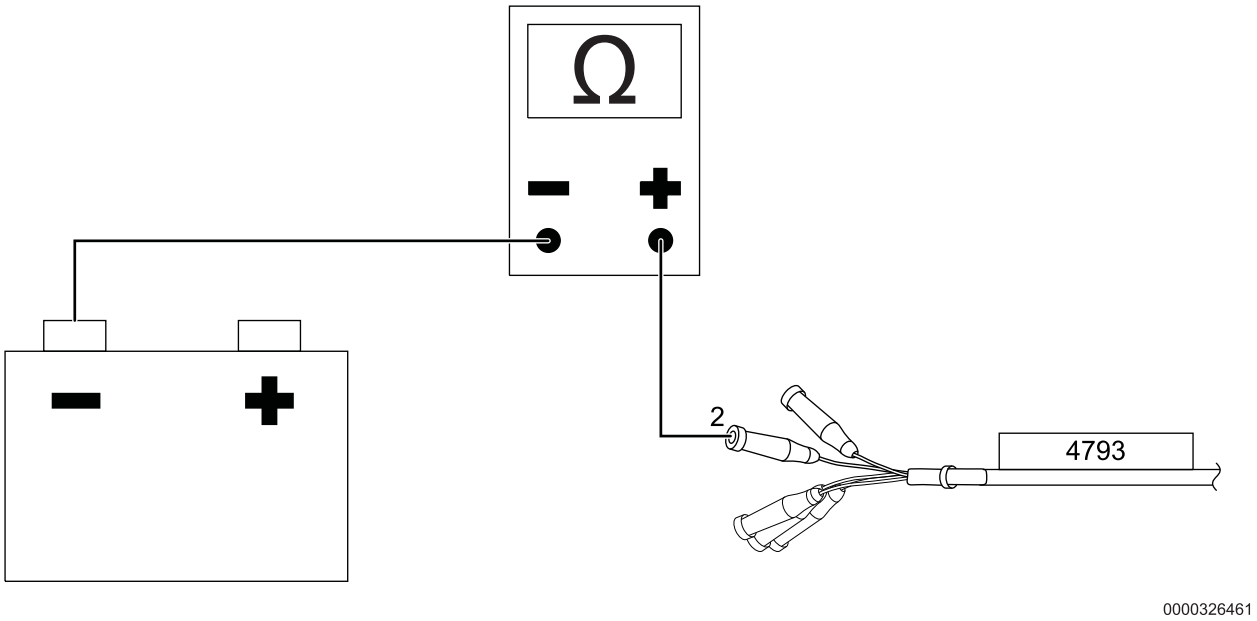


Figure 596 Test 20 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 20 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 20	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 21.
	No: Repair short to GND between Injector 1 pin-2 and ECM Driver pin D-7. After repairs are complete, retest for SPN 2797 FMI 6.

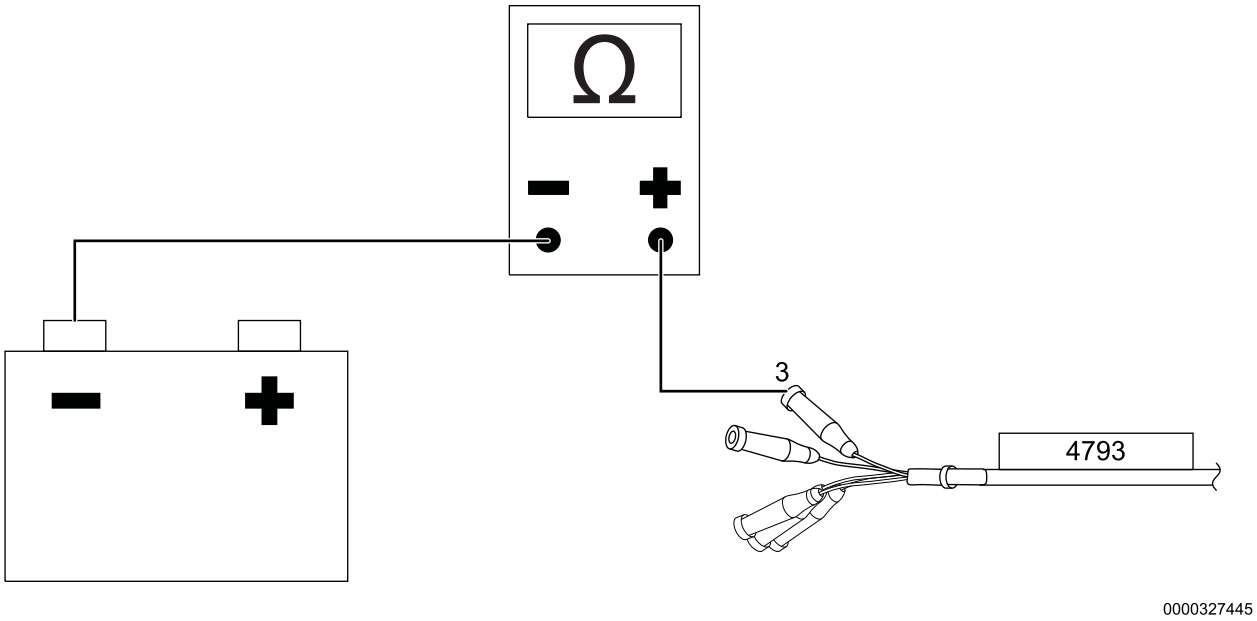


Figure 597 Test 21 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 21 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 21	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 22.
	No: Repair short to GND between Injector 1 pin-3 and ECM Driver pin D-1. After repairs are complete, retest for SPN 2797 FMI 6.

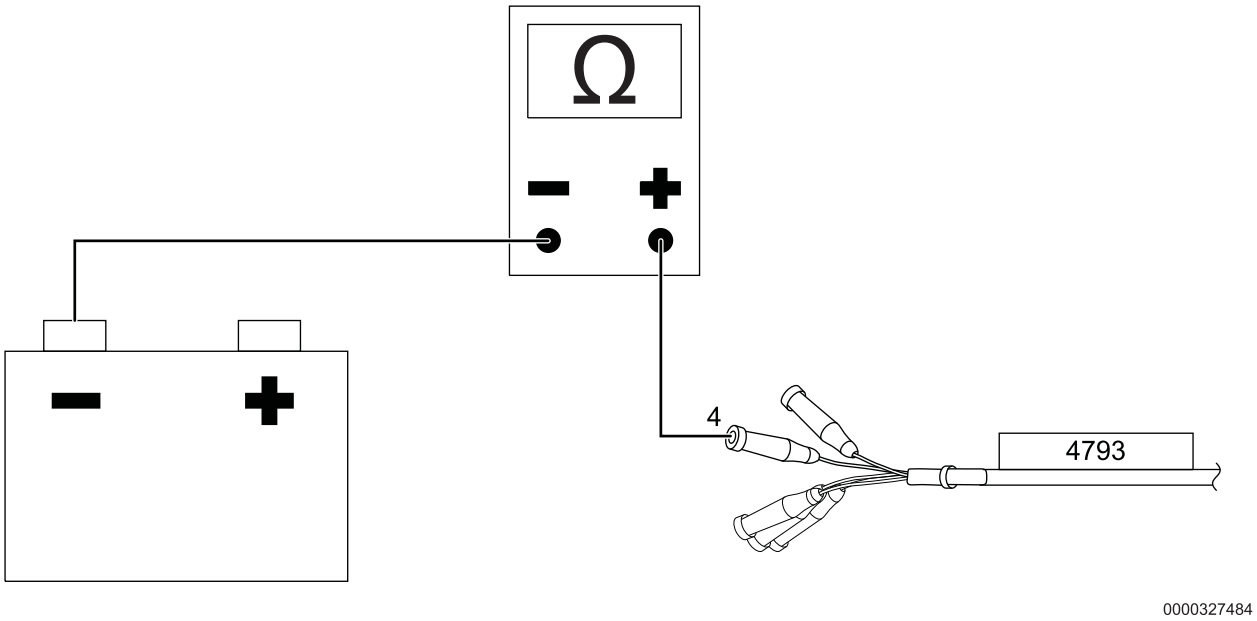


Figure 598 Test 22 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 22 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 22	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 23.
	No: Repair short to GND between Injector 1 pin-4 and ECM Driver pin D-2. After repairs are complete, retest for SPN 2797 FMI 6.

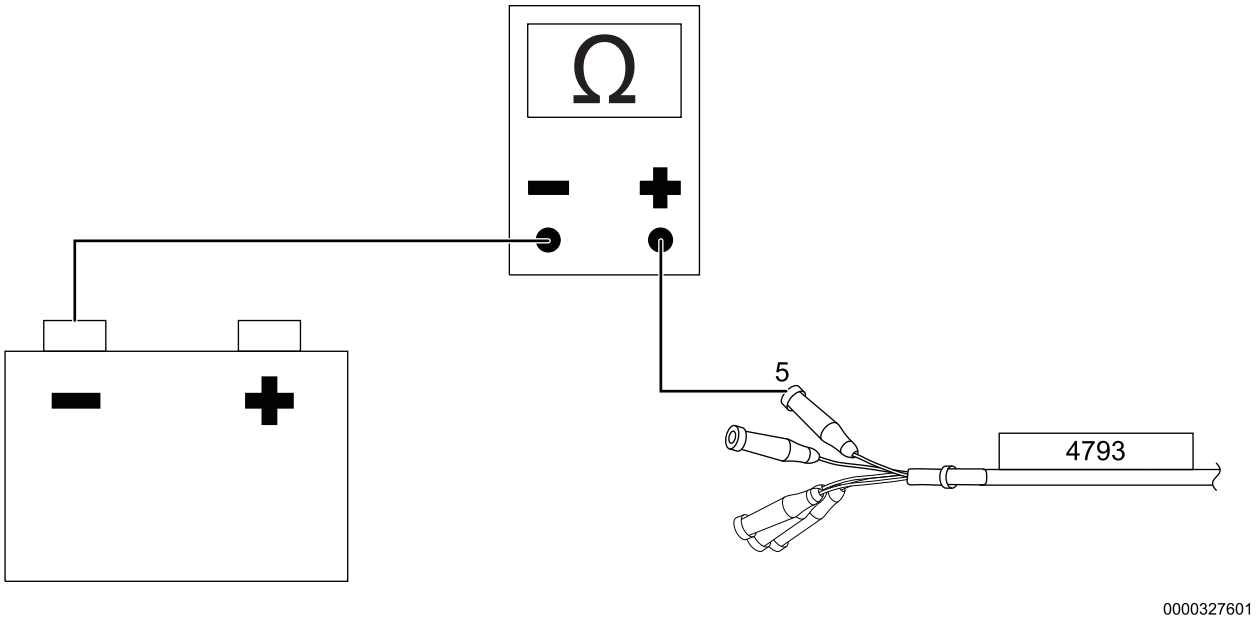


Figure 599 Test 23 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 23 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 23	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 24.
	No: Repair short to GND between Injector 2 pin-5 and ECM Driver pin D-12. After repairs are complete, retest for SPN 2797 FMI 6.

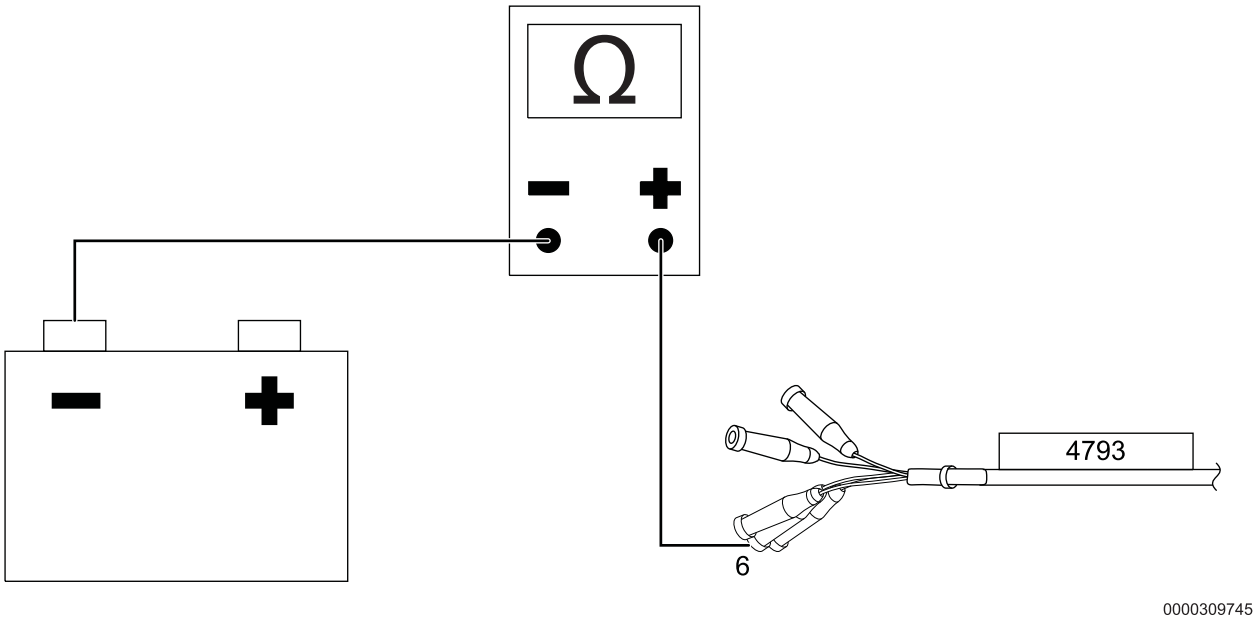


Figure 600 Test 24 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 24 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 24	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 25.
	No: Repair short to GND between Injector 2 pin-6 and ECM Driver pin D-11. After repairs are complete, retest for SPN 2797 FMI 6.

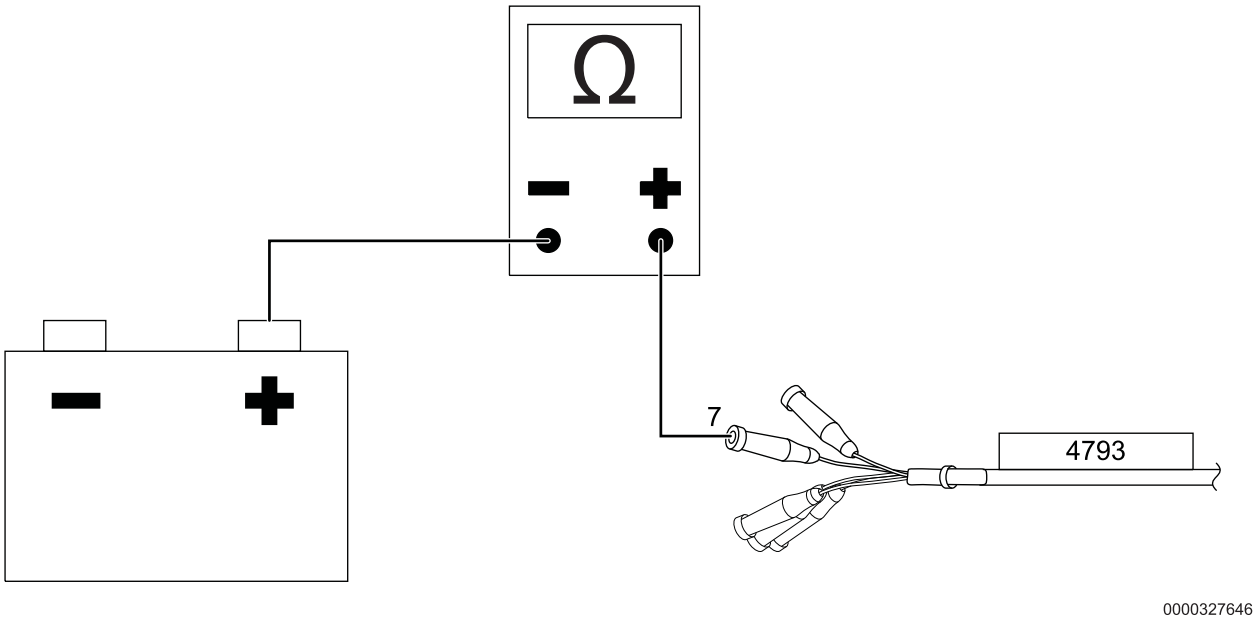


Figure 601 Test 25 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 25 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 25	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 26.
	No: Repair short to GND between Injector 2 pin-7 and ECM Driver pin D-5. After repairs are complete, retest for SPN 2797 FMI 6.

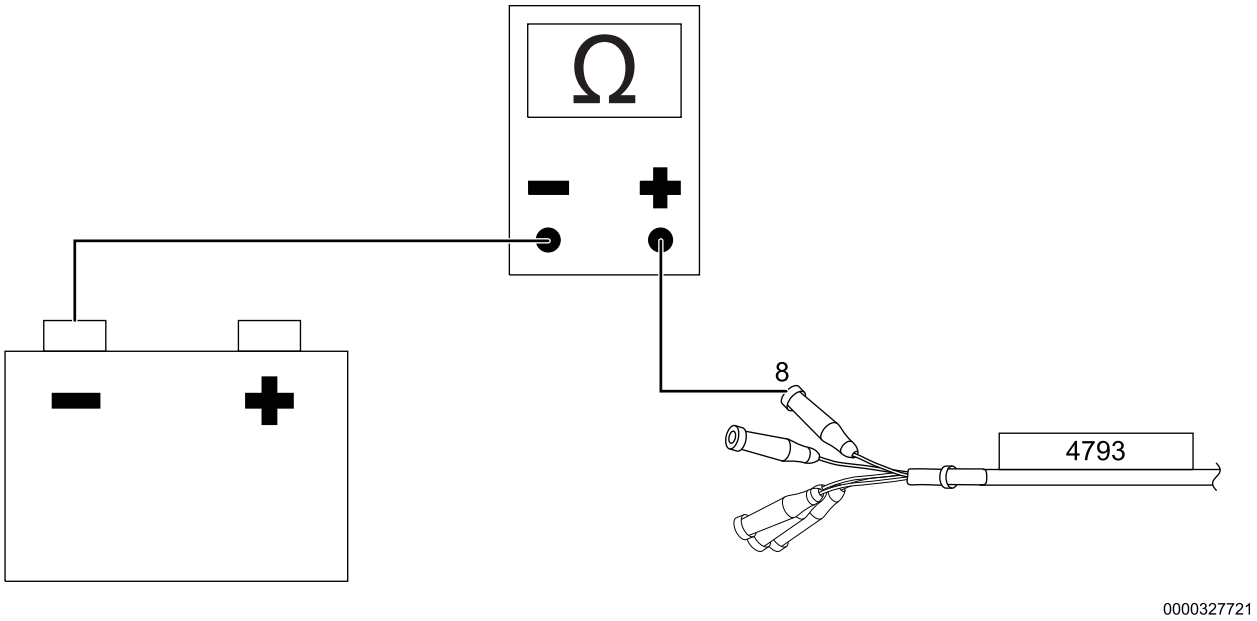


Figure 602 Test 26 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 26 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 26	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 27.
	No: Repair short to GND between Injector 2 pin-8 and ECM Driver pin D-6. After repairs are complete, retest for SPN 2797 FMI 6.

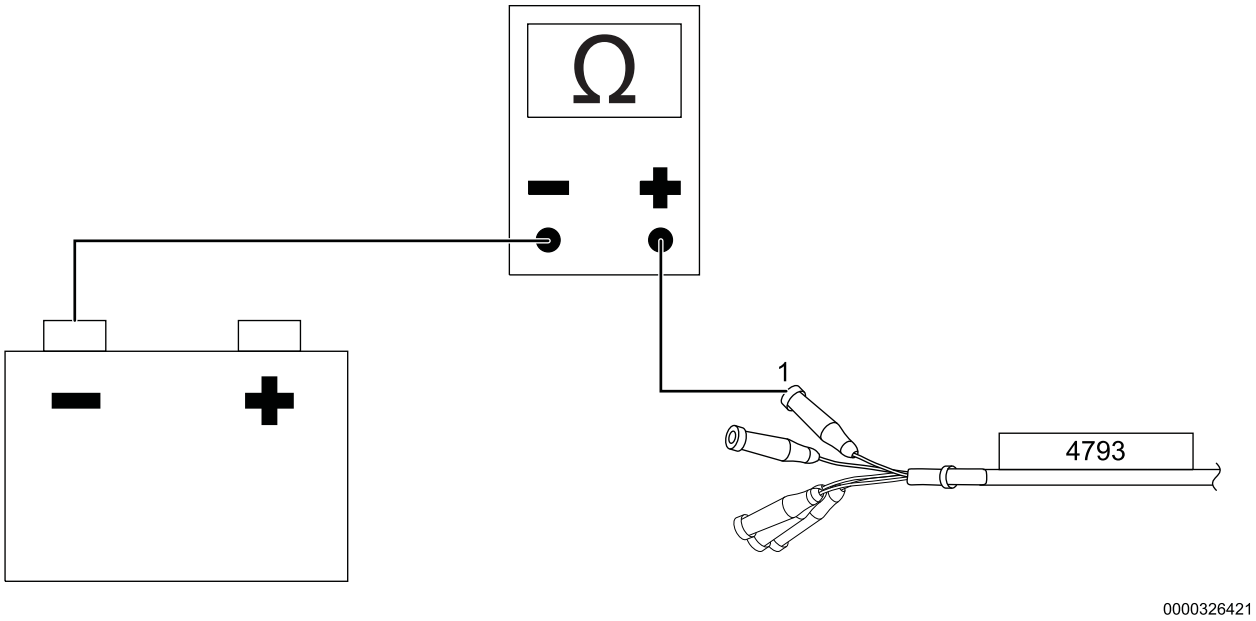


Figure 603 Test 27 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 27 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 27	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 28.
	No: Repair short to GND between Injector 3 pin-1 and ECM Driver pin D-10. After repairs are complete, retest for SPN 2797 FMI 6.

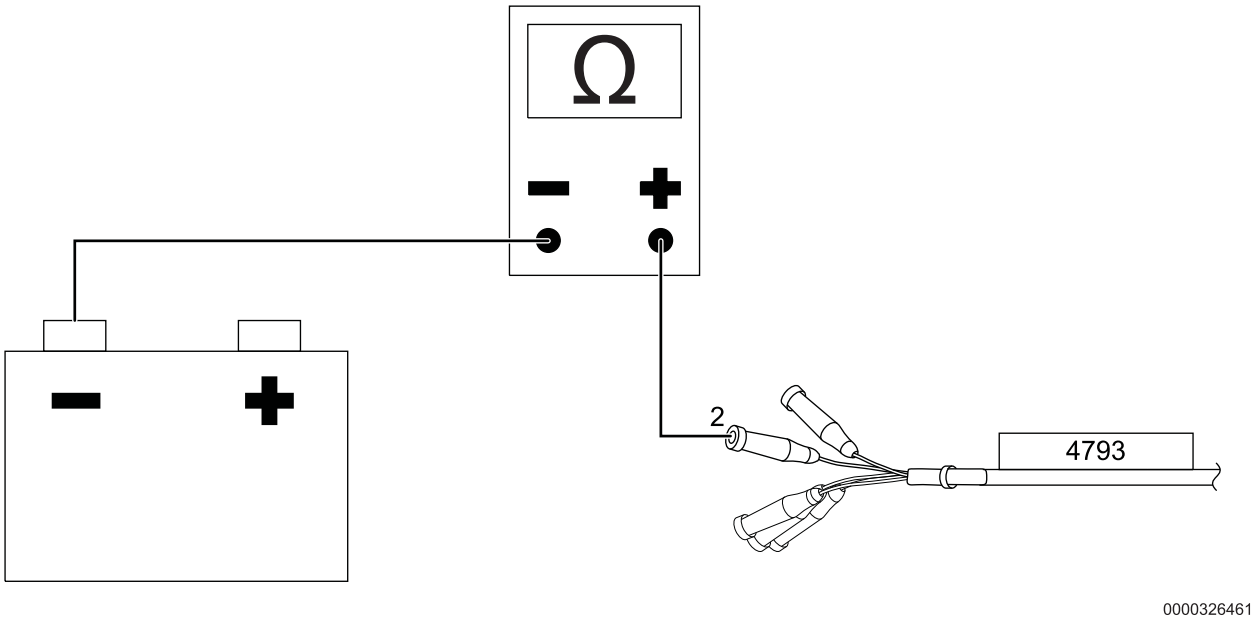


Figure 604 Test 28 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 28 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 28	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 29.
	No: Repair short to GND between Injector 3 pin-2 and ECM Driver pin D-9. After repairs are complete, retest for SPN 2797 FMI 6.

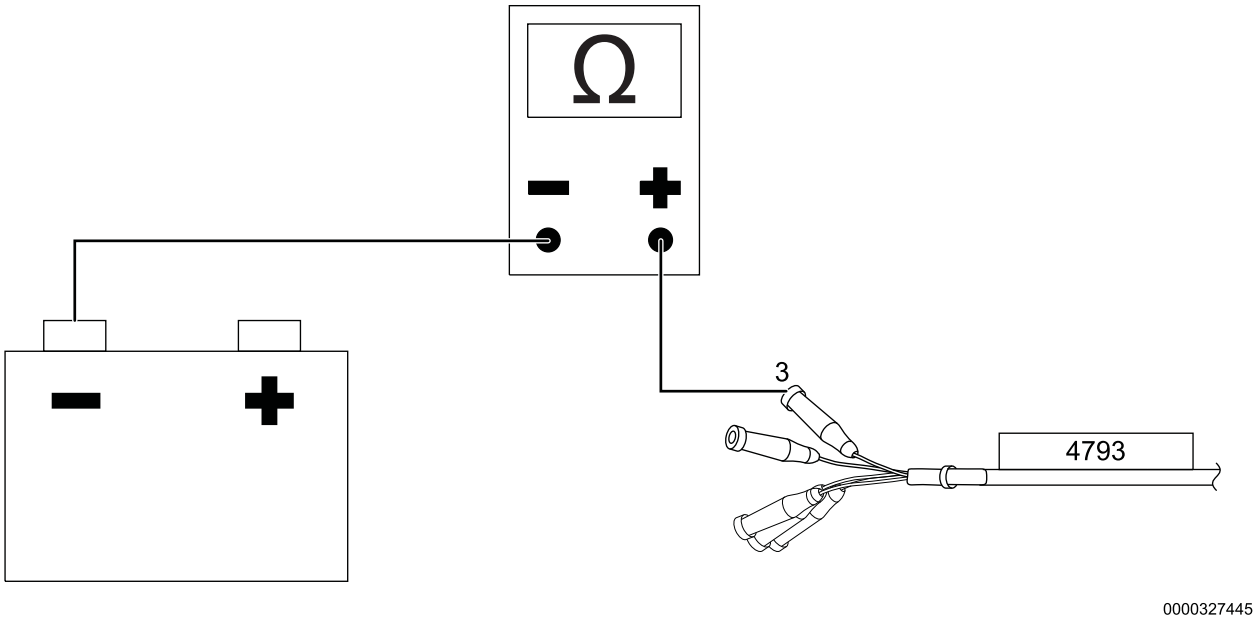


Figure 605 Test 29 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 29 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 29	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 30.
	No: Repair short to GND between Injector 3 pin-3 and ECM Driver pin D-3. After repairs are complete, retest for SPN 2797 FMI 6.

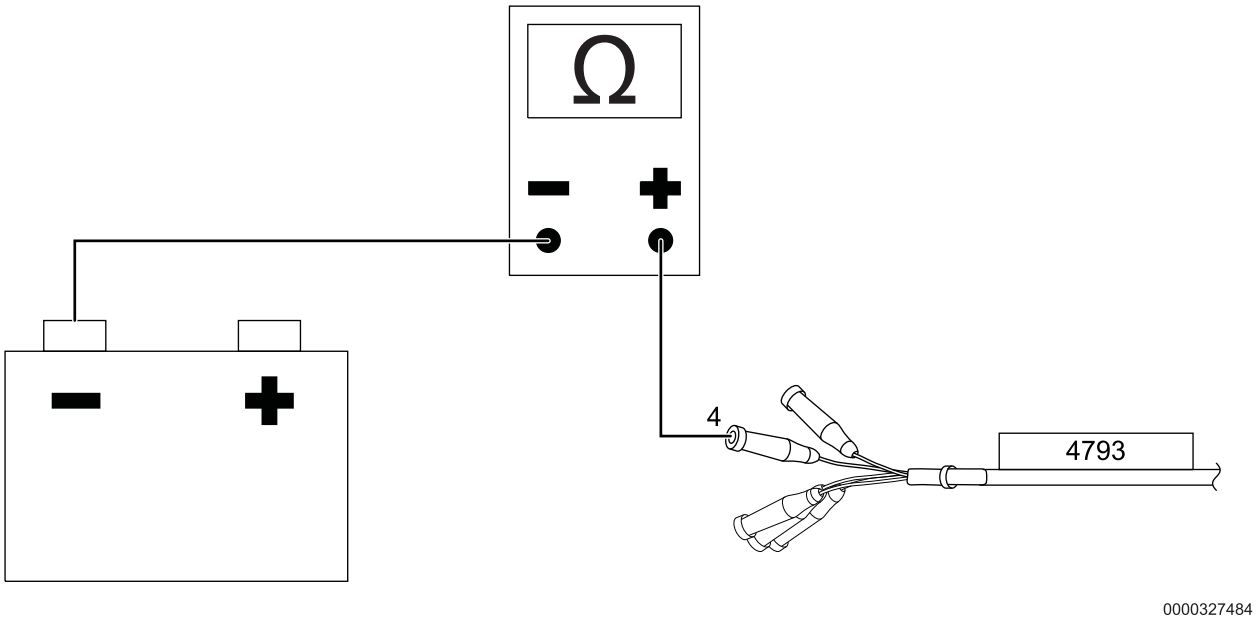


Figure 606 Test 30 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 30 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 30	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 31.
	No: Repair short to GND between Injector 3 pin-4 and ECM Driver pin D-4. After repairs are complete, retest for SPN 2797 FMI 6.

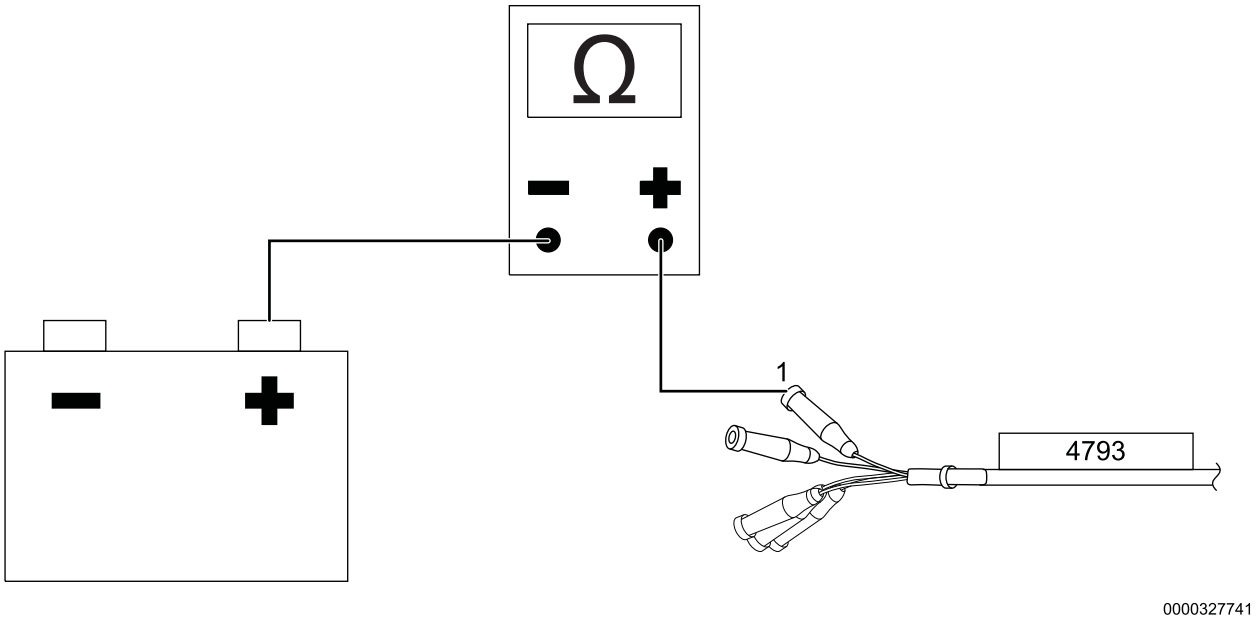


Figure 607 Test 31 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 31 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 31	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 32.
	No: Repair short to PWR between Injector 1 pin-1 and ECM Driver pin D-8. After repairs are complete, retest for SPN 2797 FMI 6.

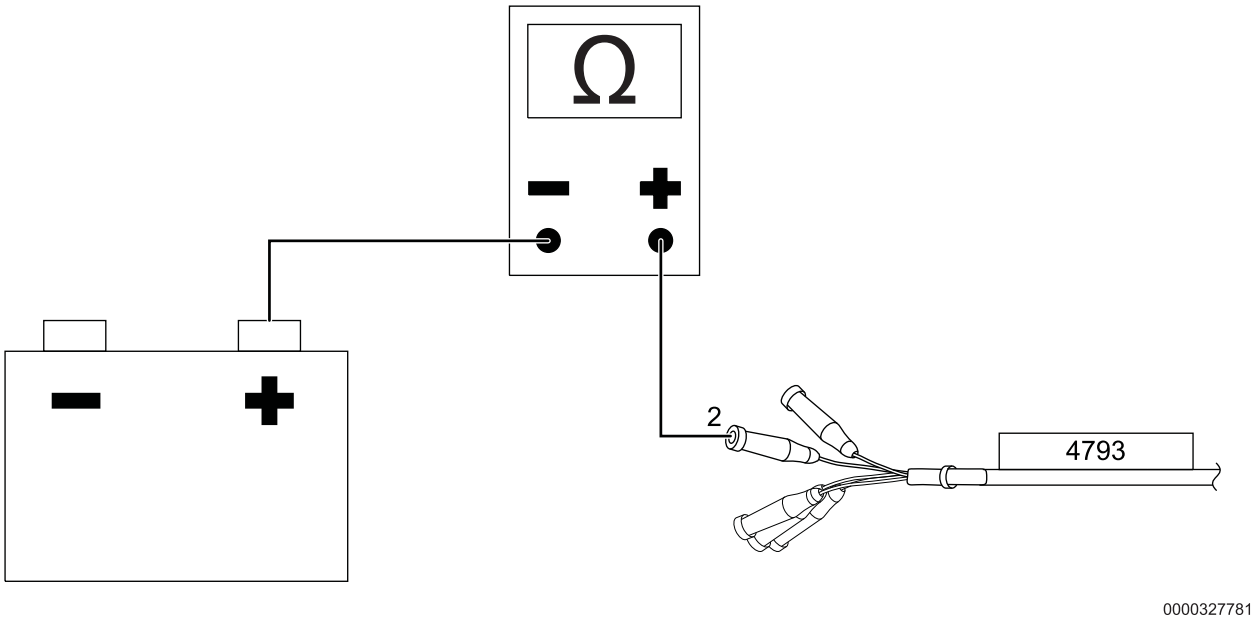


Figure 608 Test 32 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 32 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 32	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 33.
	No: Repair short to PWR between Injector 1 pin-2 and ECM Driver pin D-7. After repairs are complete, retest for SPN 2797 FMI 6.

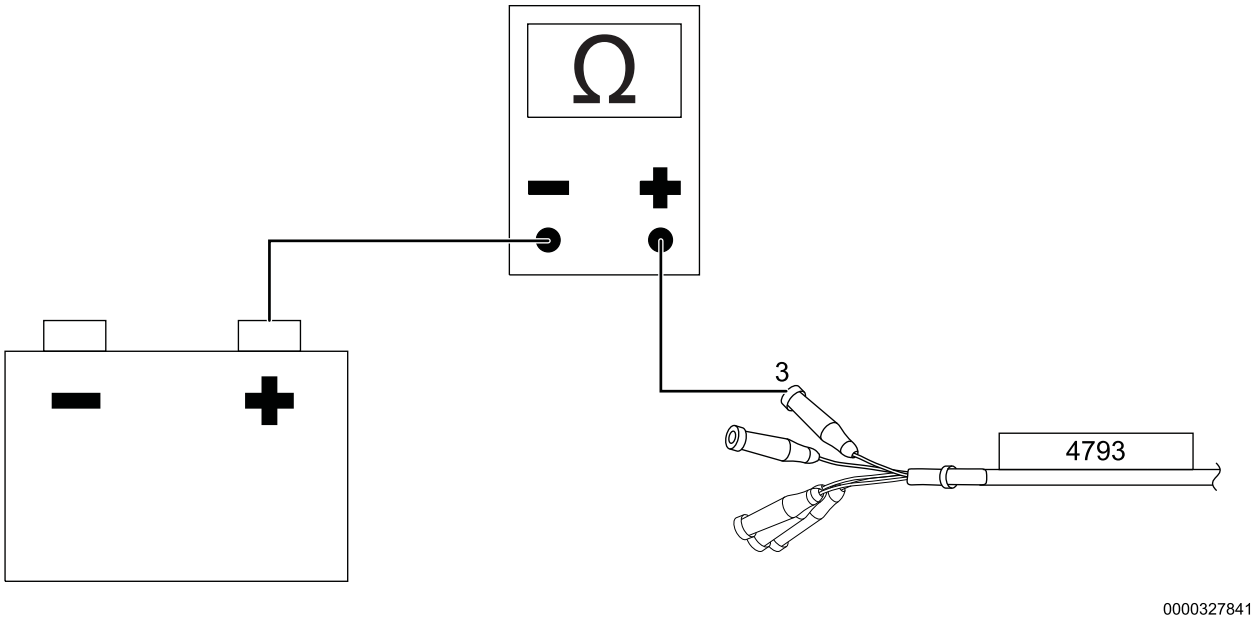


Figure 609 Test 33 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 33 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 33	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 34.
	No: Repair short to PWR between Injector 1 pin-3 and ECM Driver pin D-1. After repairs are complete, retest for SPN 2797 FMI 6.

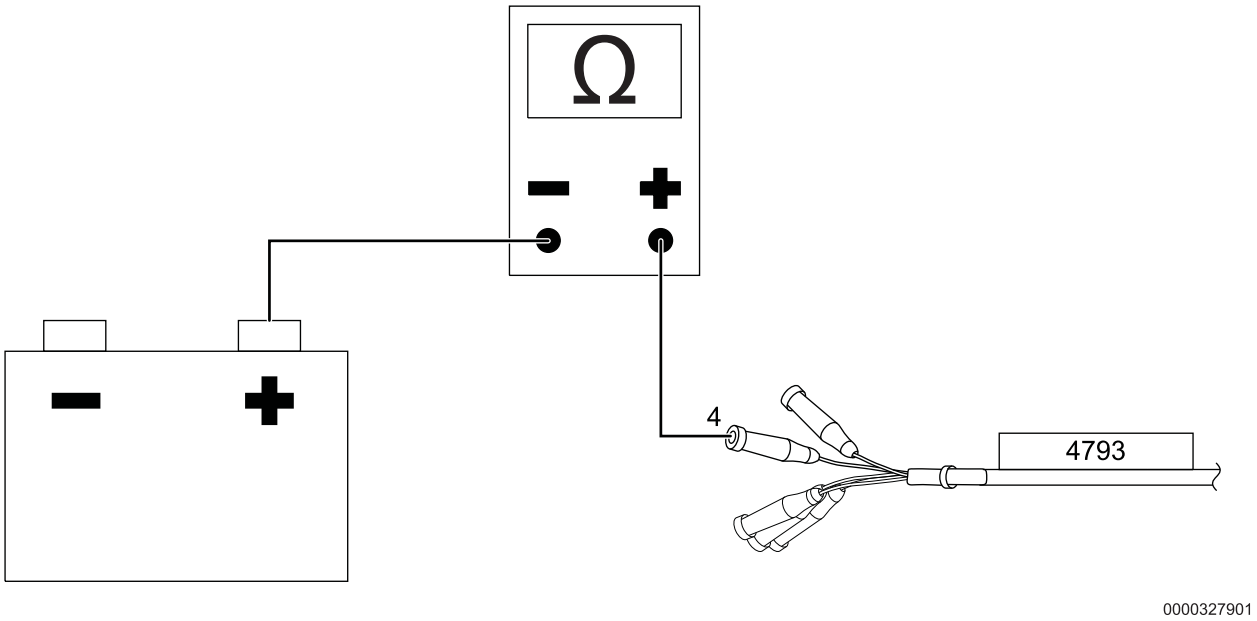


Figure 610 Test 34 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 34 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 34	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 35.
	No: Repair short to PWR between Injector 1 pin-4 and ECM Driver pin D-2. After repairs are complete, retest for SPN 2797 FMI 6.

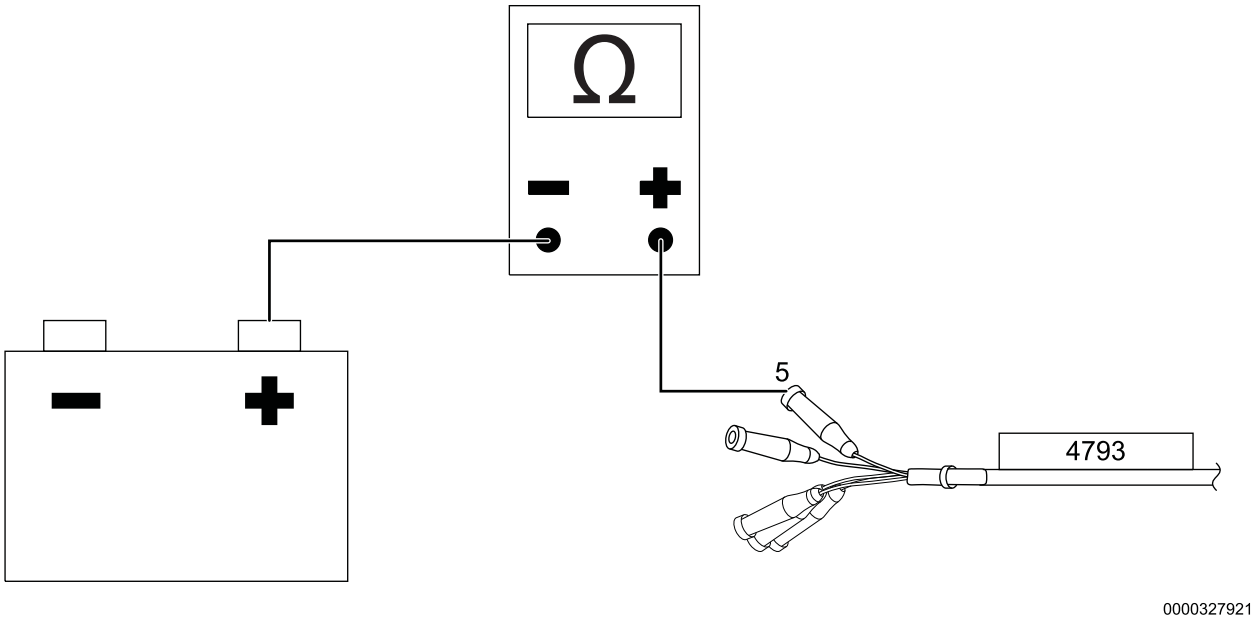


Figure 611 Test 35 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 35 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 35	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 36.
	No: Repair short to PWR between Injector 2 pin-5 and ECM Driver pin D-12. After repairs are complete, retest for SPN 2797 FMI 6.

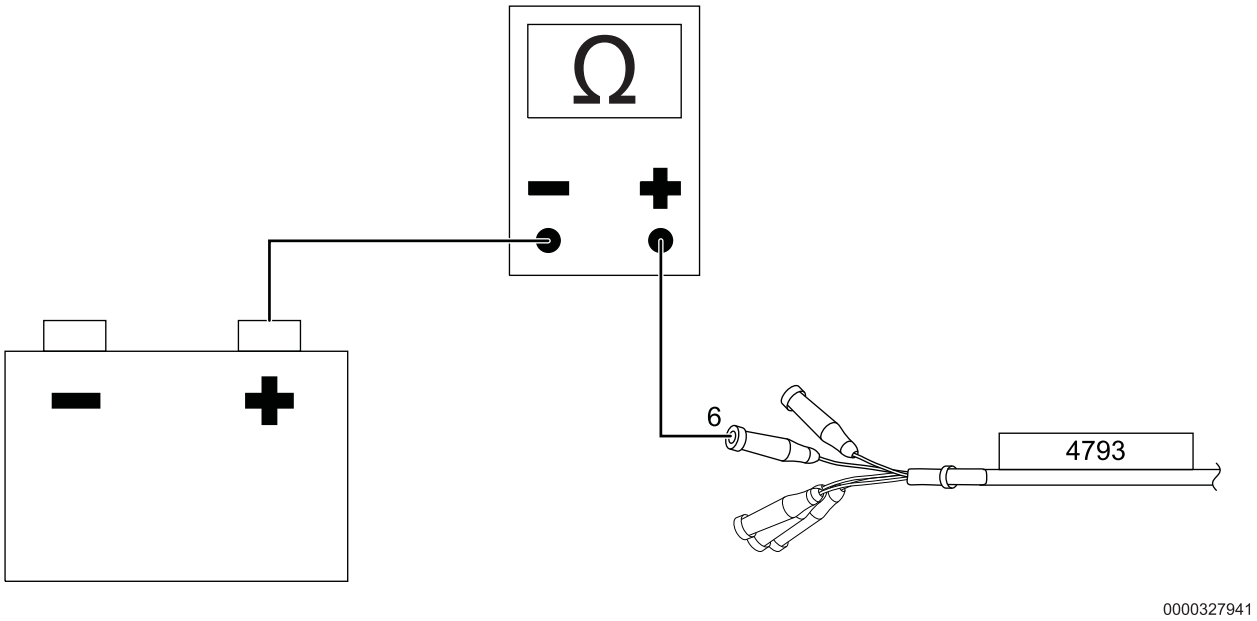


Figure 612 Test 36 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 36 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 36	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 36.
	No: Repair short to GND between Injector 2 pin-6 and ECM Driver pin D-11. After repairs are complete, retest for SPN 2797 FMI 6.

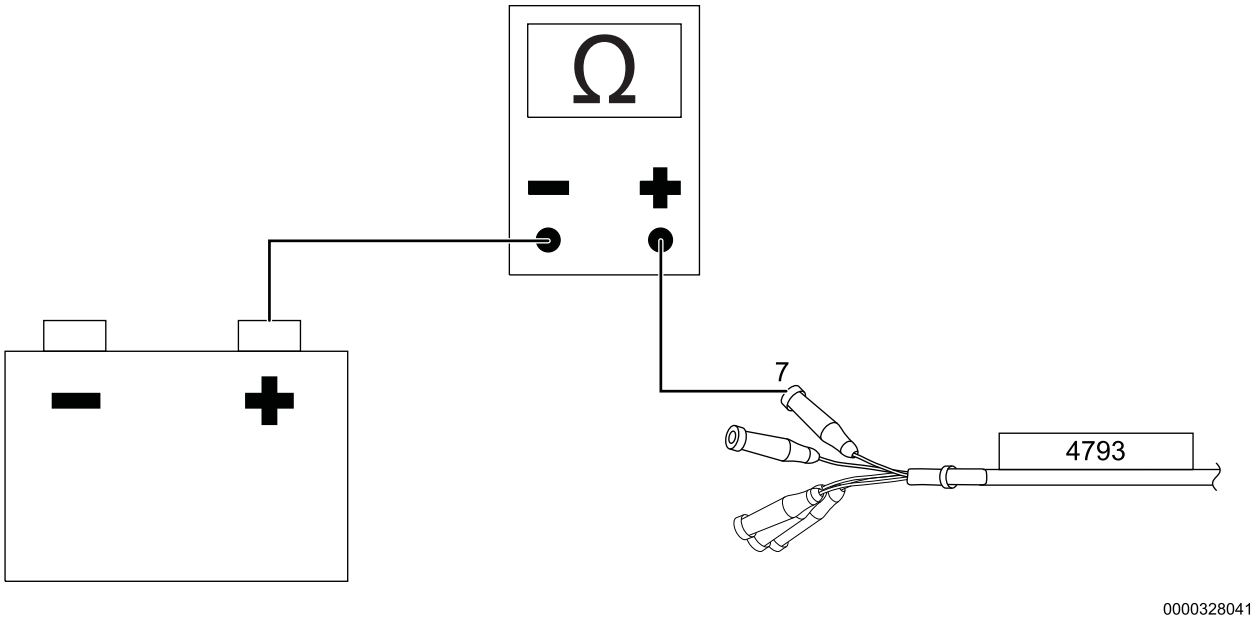


Figure 613 Test 37 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 37 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 37	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 38.
	No: Repair short to PWR between Injector 2 pin-7 and ECM Driver pin D-5. After repairs are complete, retest for SPN 2797 FMI 6.

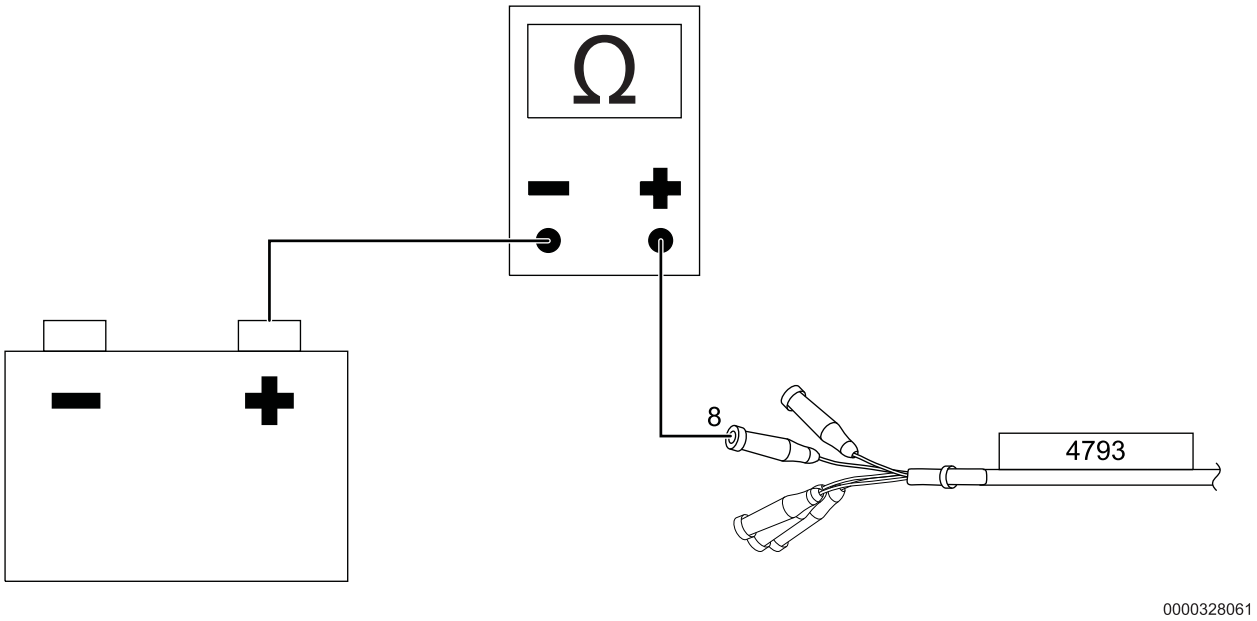


Figure 614 Test 38 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 38 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 38	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 39.
	No: Repair short to GND between Injector 2 pin-8 and ECM Driver pin D-6. After repairs are complete, retest for SPN 2797 FMI 6.

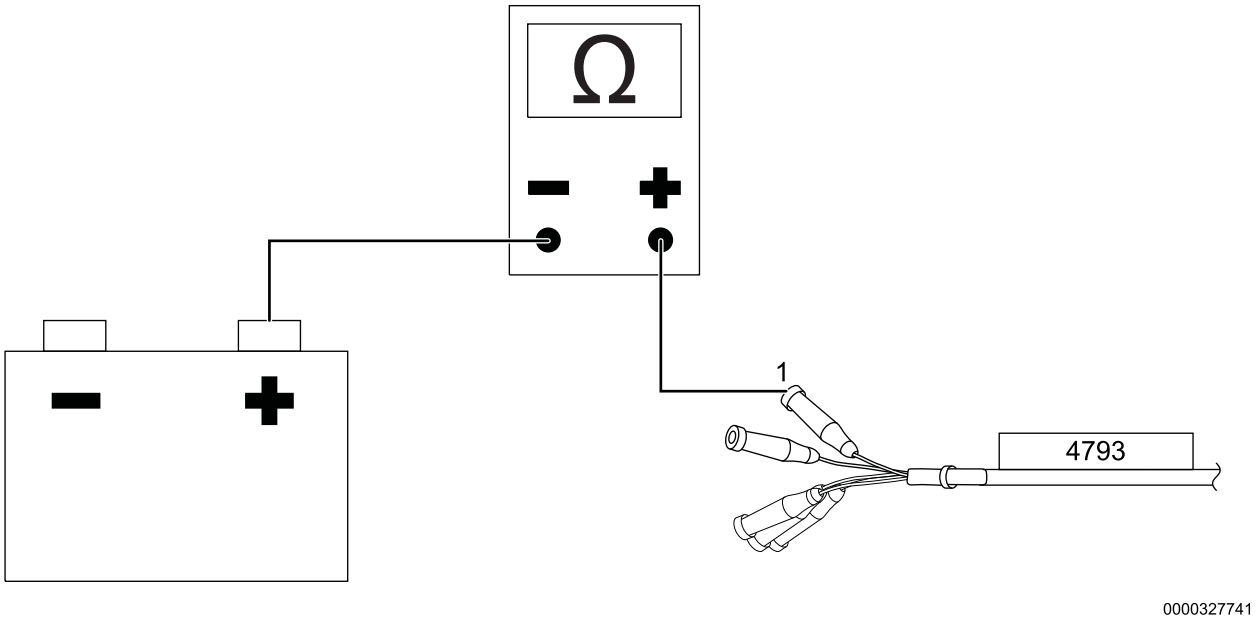


Figure 615 Test 39 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 39 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 39	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 40.
	No: Repair short to PWR between Injector 3 pin-1 and ECM Driver pin D-10. After repairs are complete, retest for SPN 2797 FMI 6.

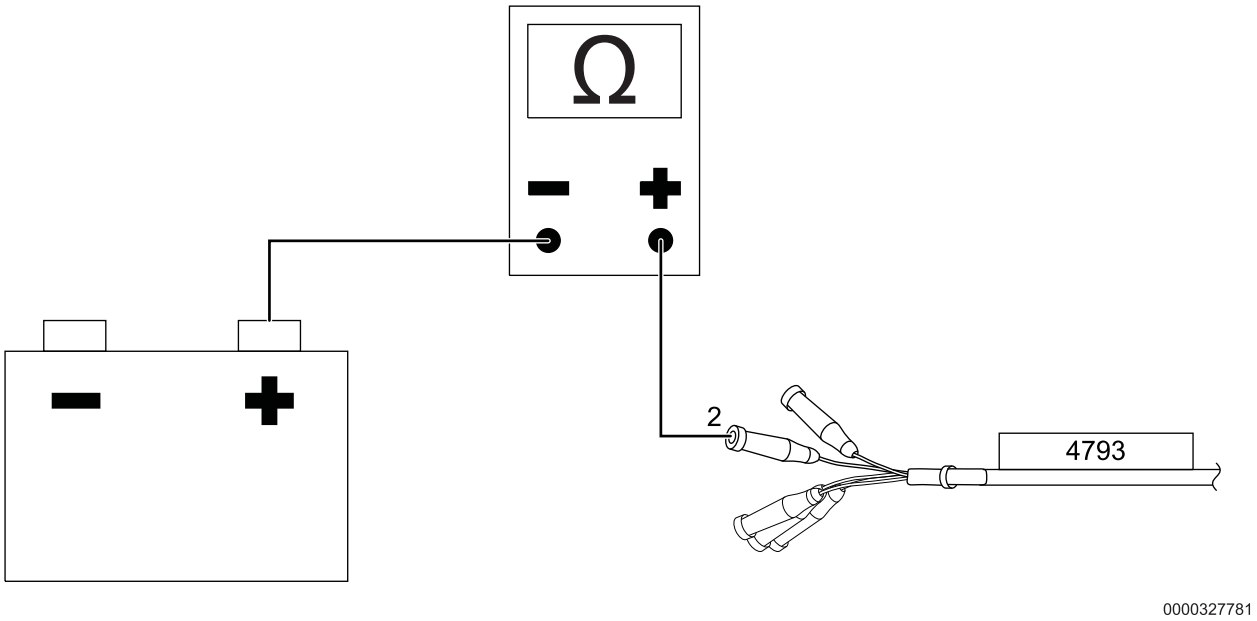


Figure 616 Test 40 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 40 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 40	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 41.
	No: Repair short to PWR between Injector 3 pin-2 and ECM Driver pin D-9. After repairs are complete, retest for SPN 2797 FMI 6.

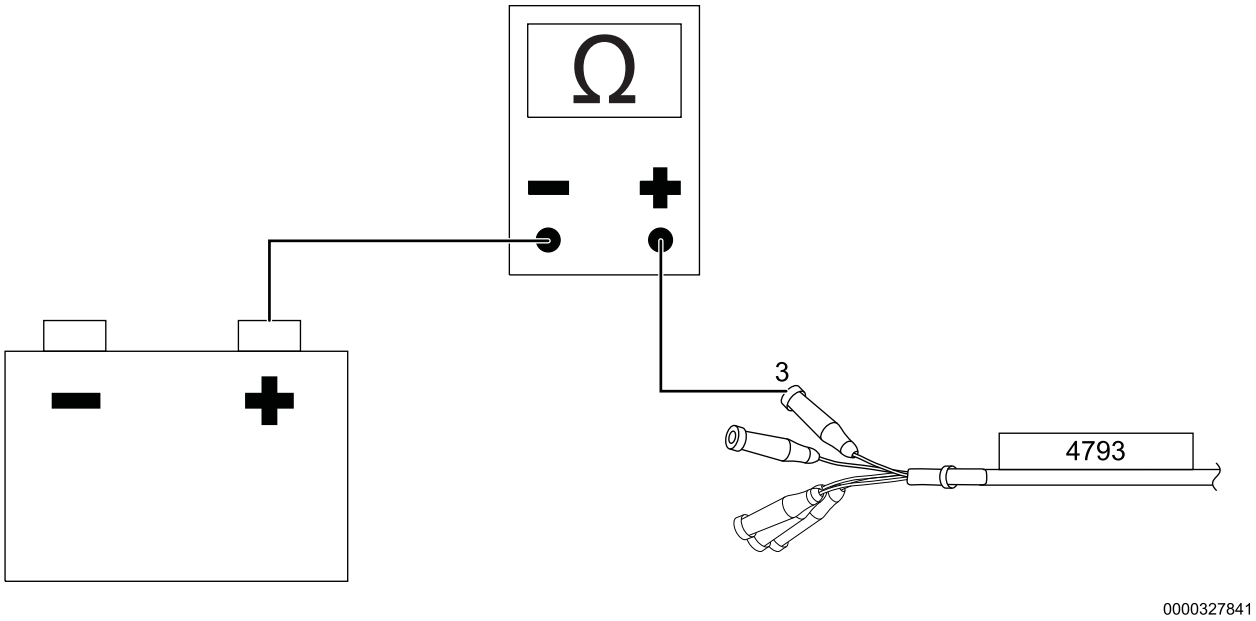


Figure 617 Test 41 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 41 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 41	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR between UVC connector 3 pin-4 and ECM Driver pin D-4. After repairs are complete, retest for SPN 2797 FMI 6.
	No: Repair short to PWR between Injector 3 pin-3 and ECM Driver pin D-3. After repairs are complete, retest for SPN 2797 FMI 6.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 2797 FMI 6 fault code diagnostics.

SPN 2798 FMI 6 - Injector Control Group 2 - short circuit (INJ 4, 5, 6)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on Bank 1 Open coil {Bank 1: Injector Number 4, 5 and 6} Short circuit detection on Bank 1 Close coil { Bank 1 : Injector Number 4, 5 and 6 }	Driver indicates short circuit on Open coil. Current detected by driver > 50 Amps Driver indicates short circuit on Close coil. Current detected by driver > 50 Amps	Key ON, Engine Running Battery voltage > 9 Volts Injectors firing

Fault Overview

Fault code sets when short circuit is detected on Bank 1 (Injectors 4, 5, and 6) Open or Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

• SPN 654-656 FMI 4 and 5 (INJ)	• SPN 3662-3665 FMI 4 and 5 (INJ)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel injector 4 Open circuit short to GND
- Fuel injector 4 Close circuit short to GND
- Fuel injector 4 Open circuit short to PWR
- Fuel injector 4 Close circuit short to PWR
- Fuel Injector 4 Open H shorted to Open L
- Fuel Injector 4 Close H shorted to Close L
- Fuel Injector 4 Close circuit shorted to Open circuit
- Failed Fuel Injector 4
- Fuel injector 5 Open circuit short to GND
- Fuel injector 5 Close circuit short to GND
- Fuel injector 5 Open circuit short to PWR
- Fuel injector 5 Close circuit short to PWR
- Fuel Injector 5 Open H shorted to Open L
- Fuel Injector 5 Close H shorted to Close L
- Fuel Injector 5 Close circuit shorted to Open circuit
- Failed Fuel Injector 5
- Fuel injector 6 Open circuit short to GND
- Fuel injector 6 Close circuit short to GND
- Fuel injector 6 Open circuit short to PWR
- Fuel injector 6 Close circuit short to PWR
- Fuel Injector 6 Open H shorted to Open L
- Fuel Injector 6 Close H shorted to Close L
- Fuel Injector 6 Close circuit shorted to Open circuit
- Failed Fuel Injector 6

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1611). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 2798 FMI 6.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 2798 FMI 6. Is EST DTC list SPN 2798 FMI 6 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3 C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Go to Step 4. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 2798 FMI 6.

Step 4	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
A. Key OFF B. Disconnect UVC 4 C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are

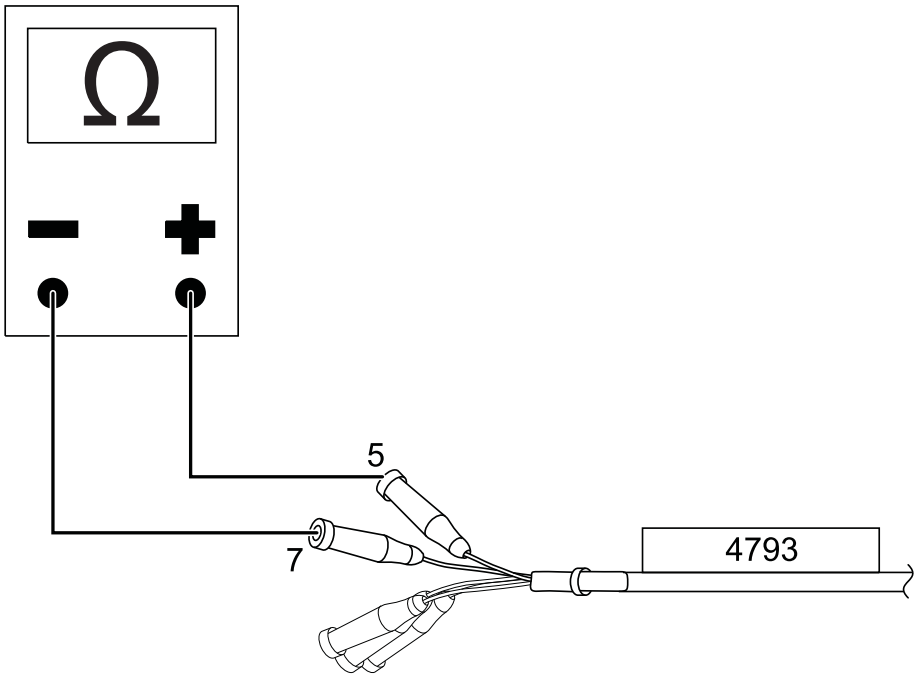
	complete, retest for SPN 2798 FMI 6.

Pin-Point Tests (SPN 2798 FMI 6)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

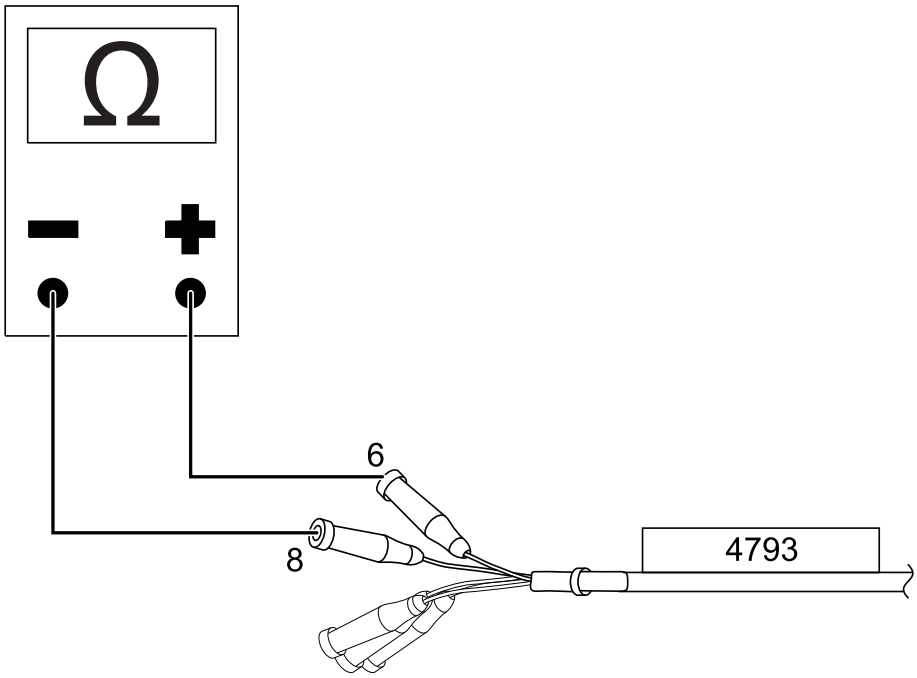


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Figure 618 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

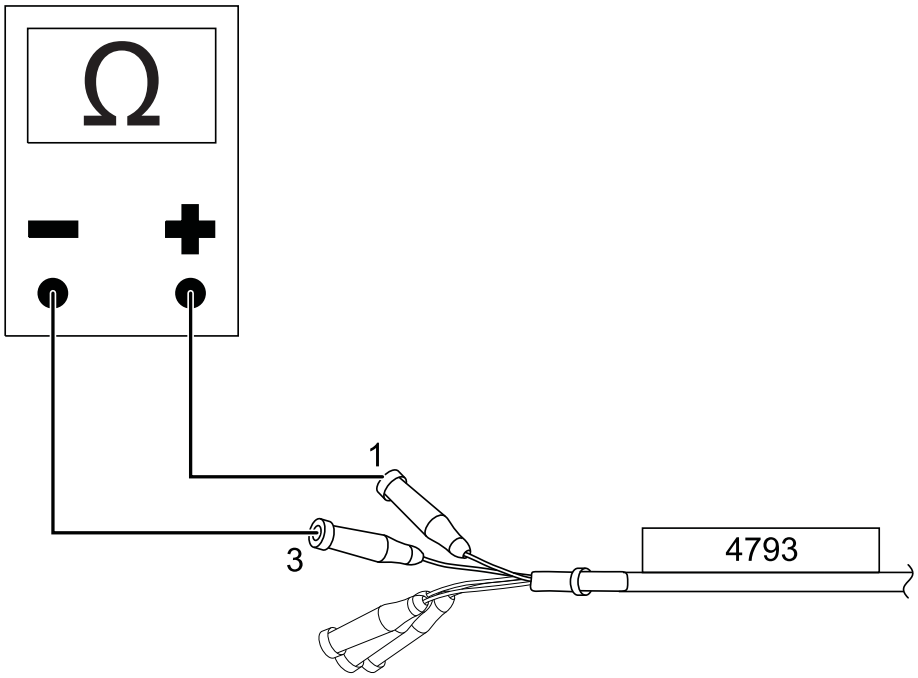


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Figure 619 Test 2 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 3.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

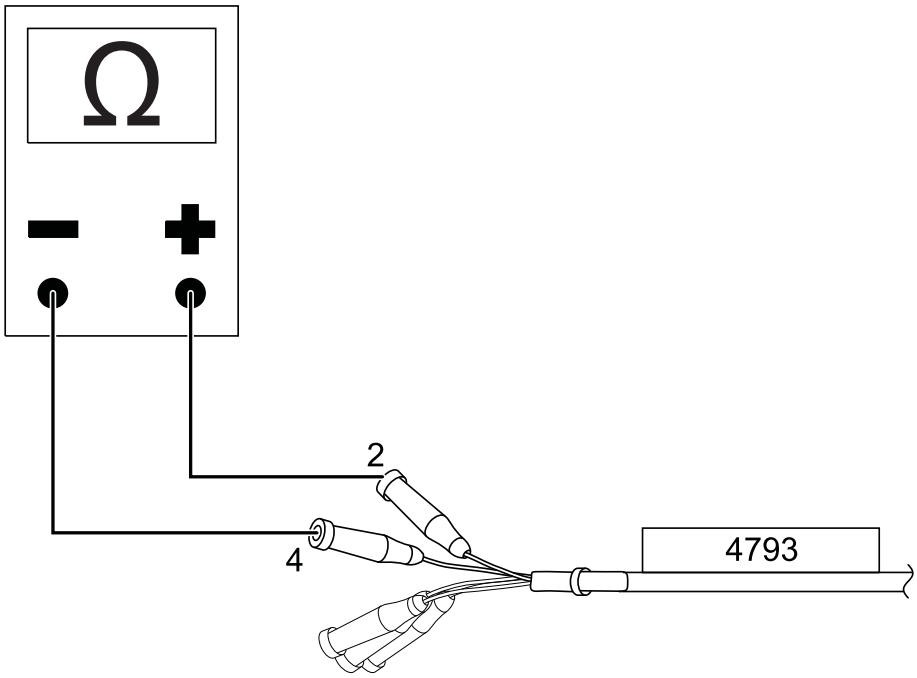


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Figure 620 Test 3 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 4.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

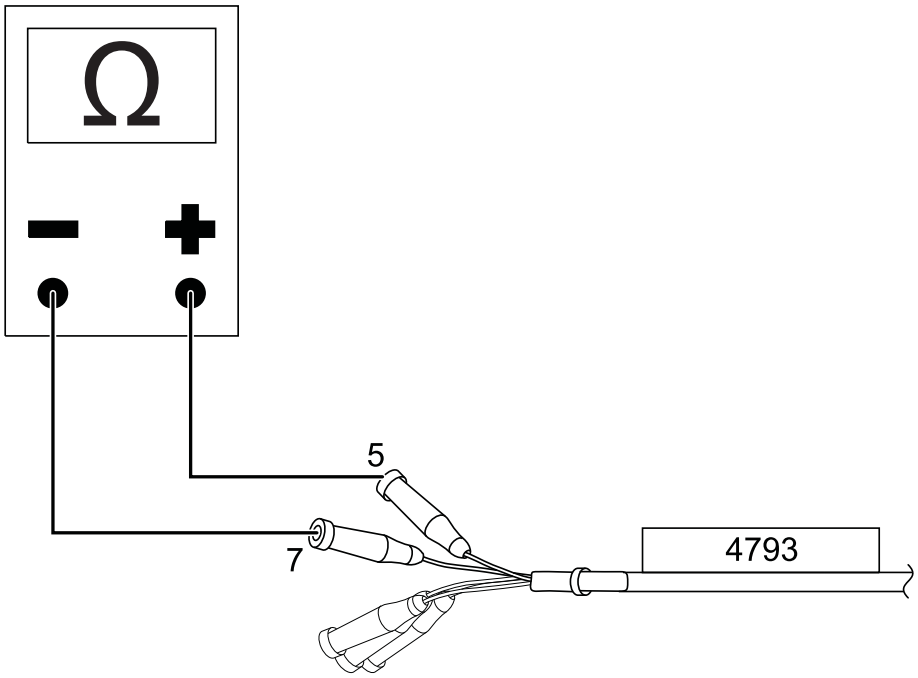


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Figure 621 Test 4 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and pin-4.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

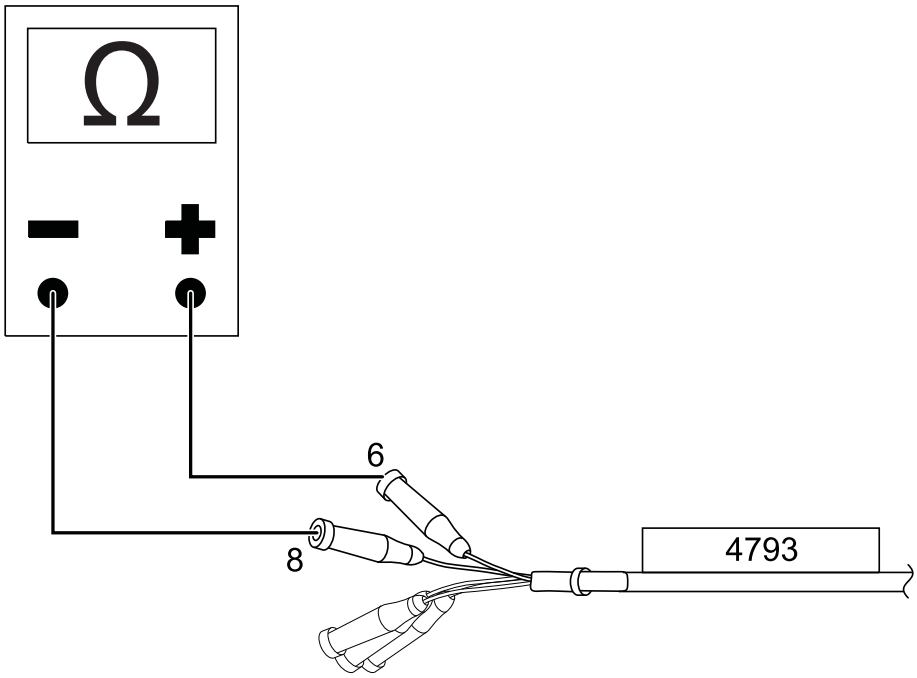


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Figure 622 Test 5 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

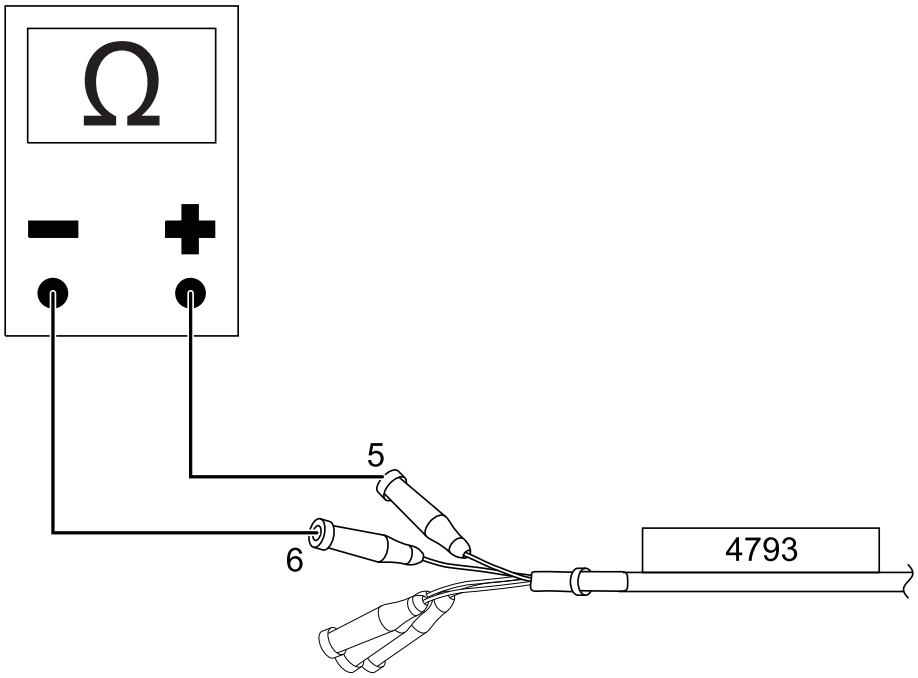


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Figure 623 Test 6 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and pin-8.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 7.
	No: Repair short between circuits. After repairs are complete, retest for SPN 2798 FMI 6

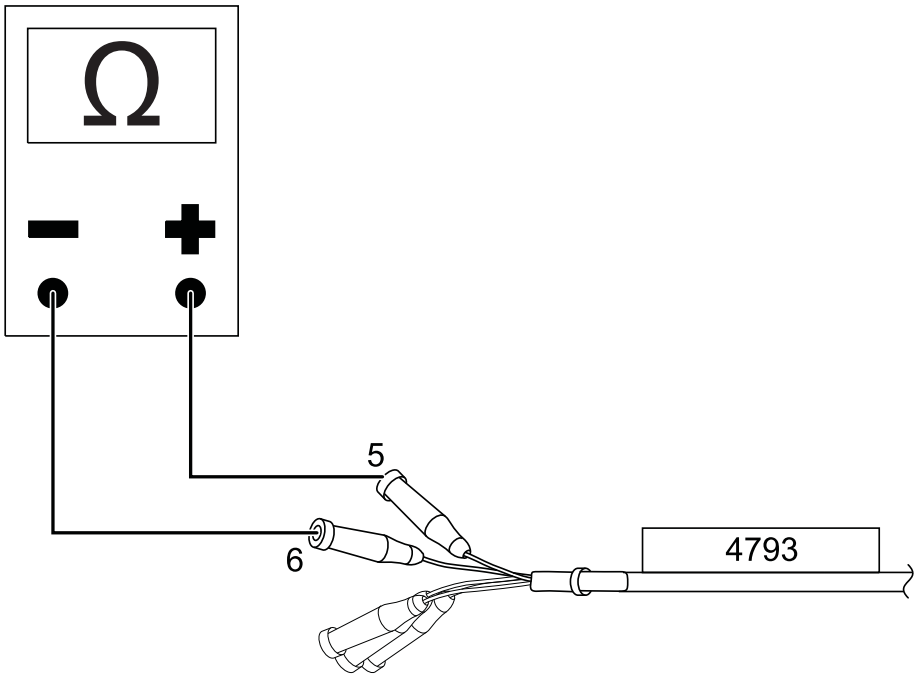


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Figure 624 Test 7 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 7	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 8.
	No: Go to Test 9.

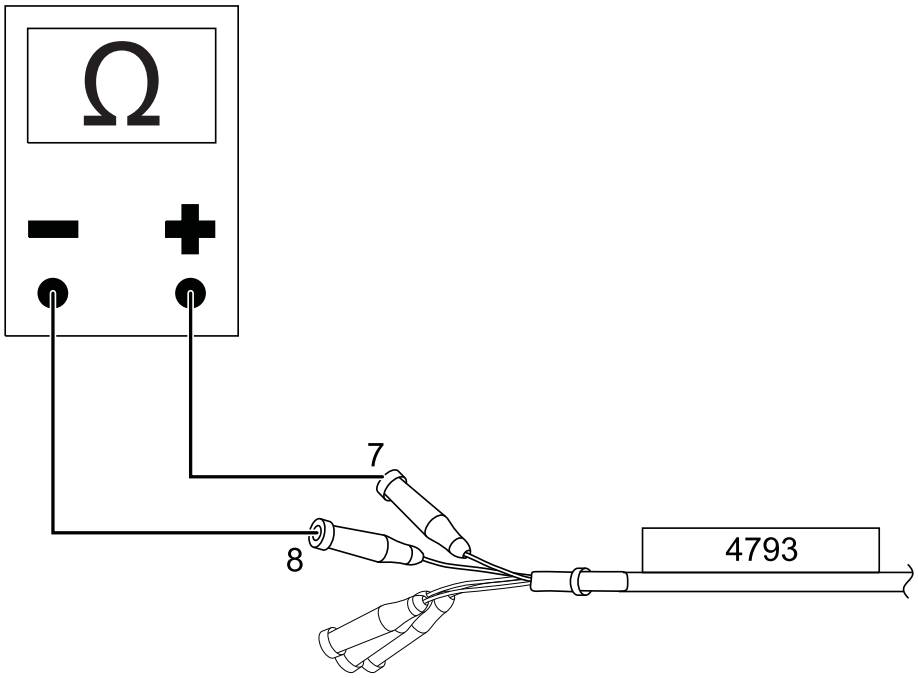


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Figure 625 Test 8 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 8 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 8	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 4 Close coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 2798 FMI 6.

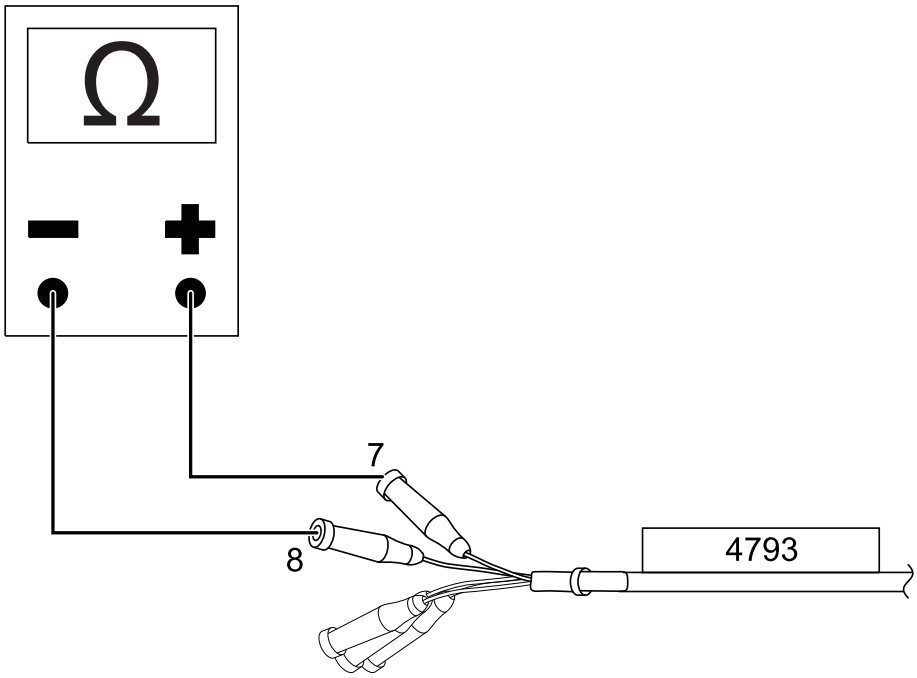


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Figure 626 Test 9 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 9 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 9	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 10.
	No: Go to Test 11.

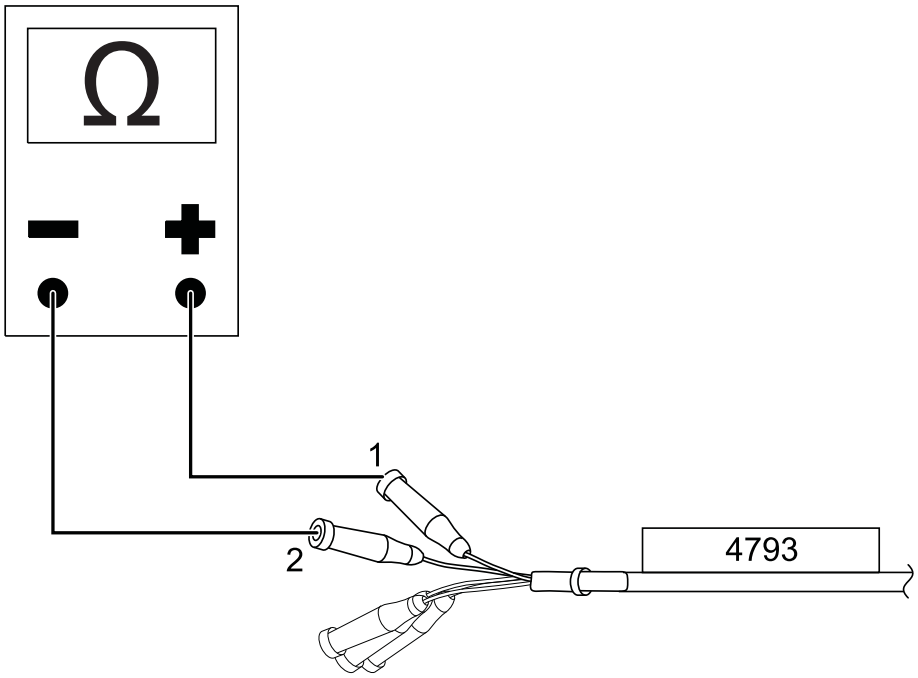


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Figure 627 Test 10 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 10 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 10	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 4 Open coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 2798 FMI 6.

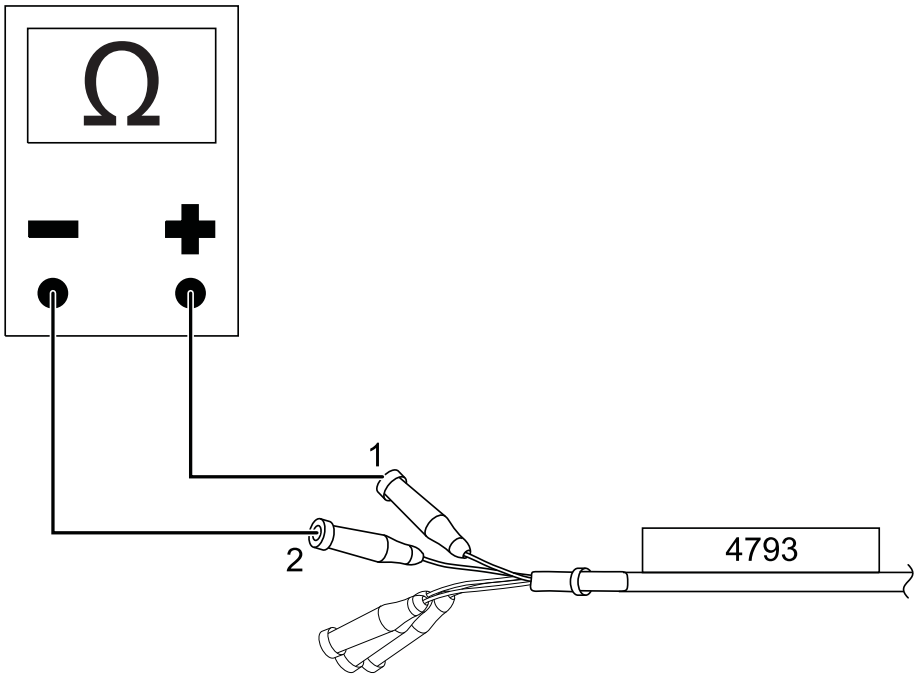


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Figure 628 Test 11 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 11 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 11	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 12.
	No: Go to Test 13.

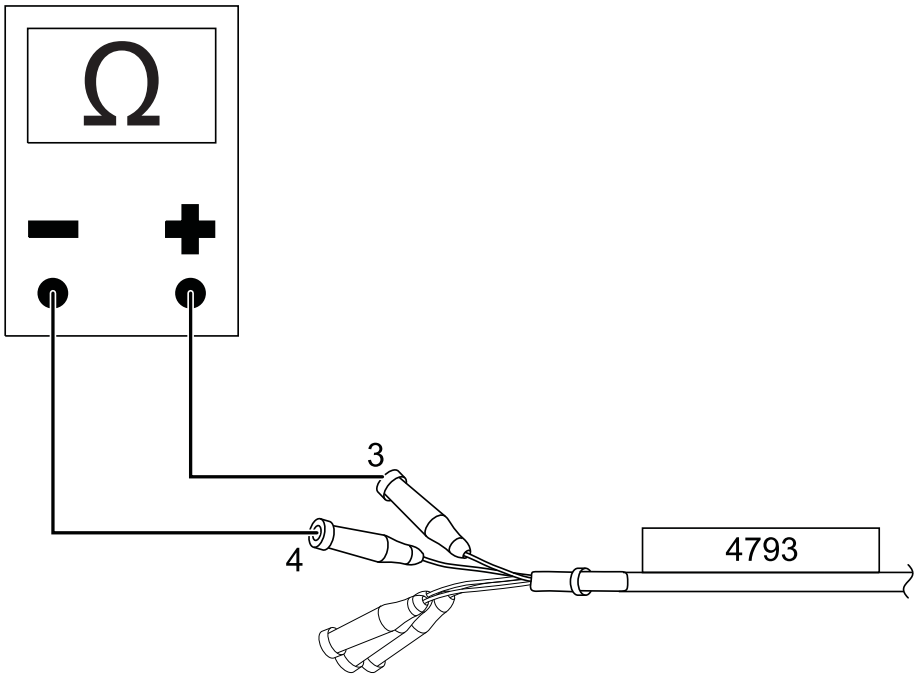


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Figure 629 Test 12 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 12 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 12	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 5 Close coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 2798 FMI 6.

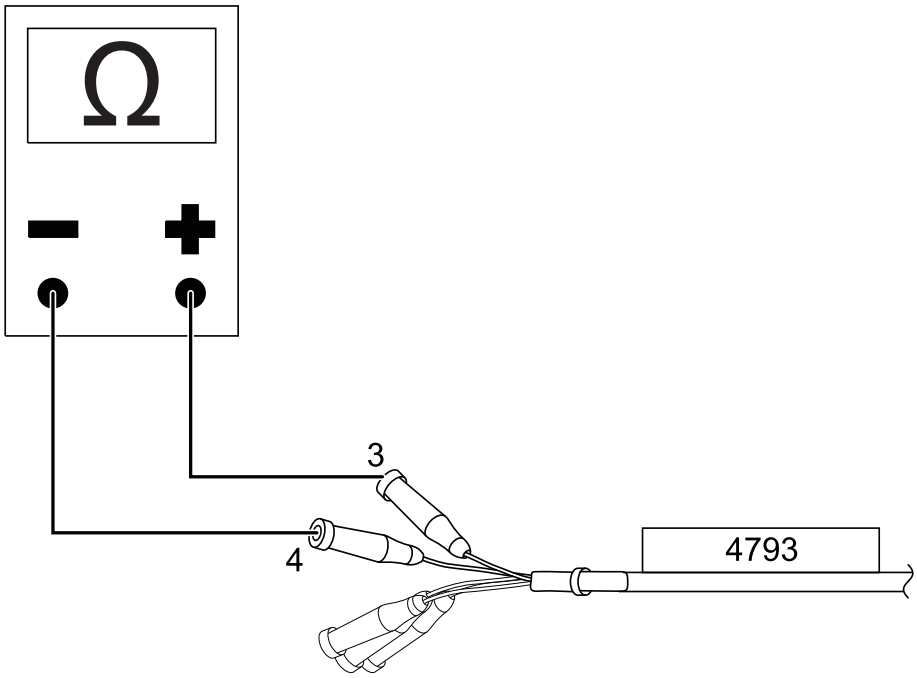


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Figure 630 Test 13 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 13 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 13	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 14.
	No: Go to Test 15.

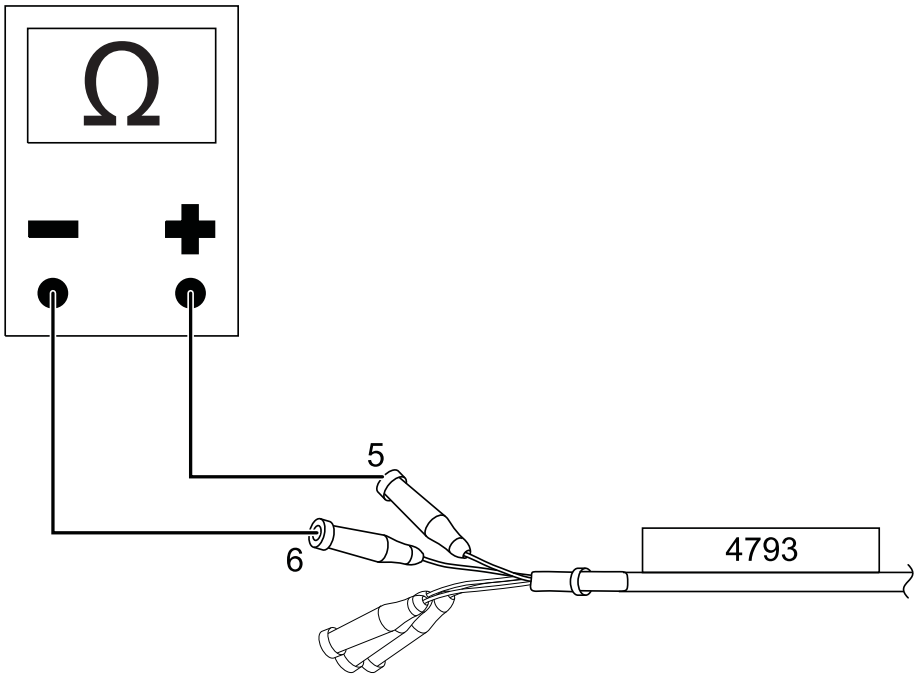


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Figure 631 Test 14 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 14 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 14	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 5 Open coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 2798 FMI 6.

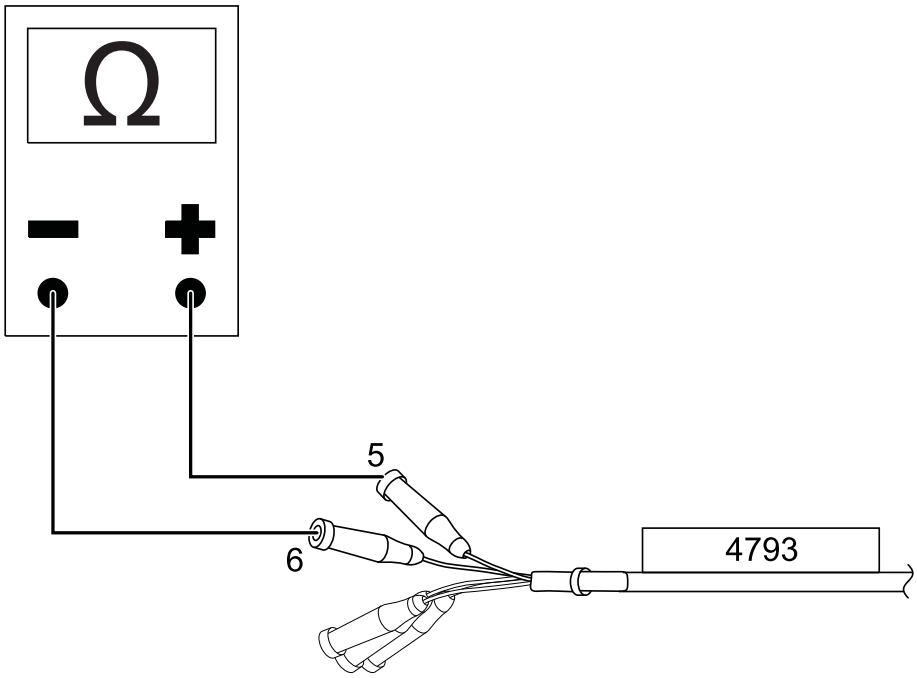


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Figure 632 Test 15 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 15 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 15	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 16.
	No: Go to Test 17.

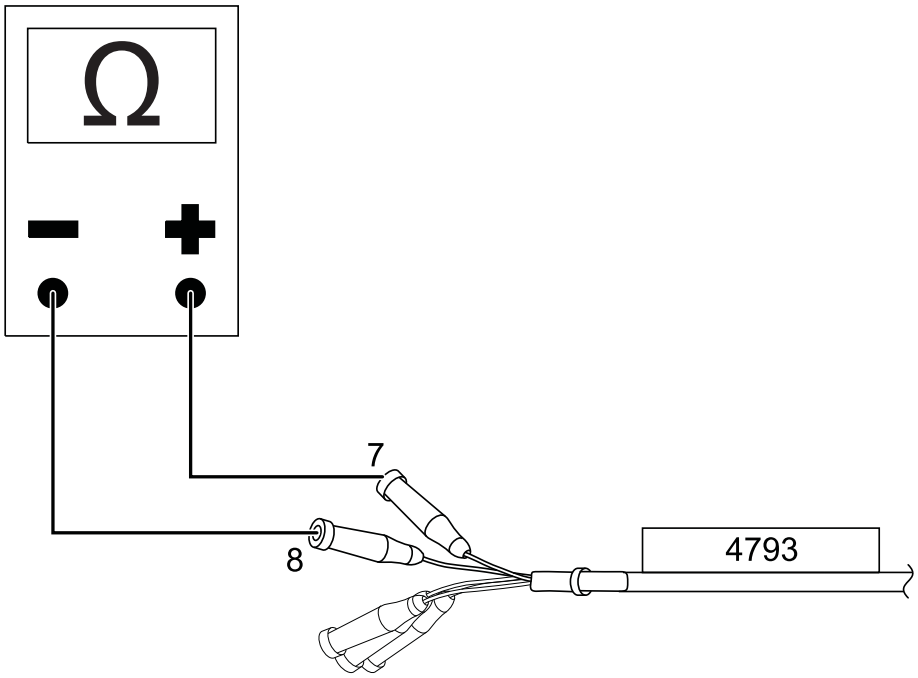


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Figure 633 Test 16 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 16 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 16	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 6 Close coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 2798 FMI 8.

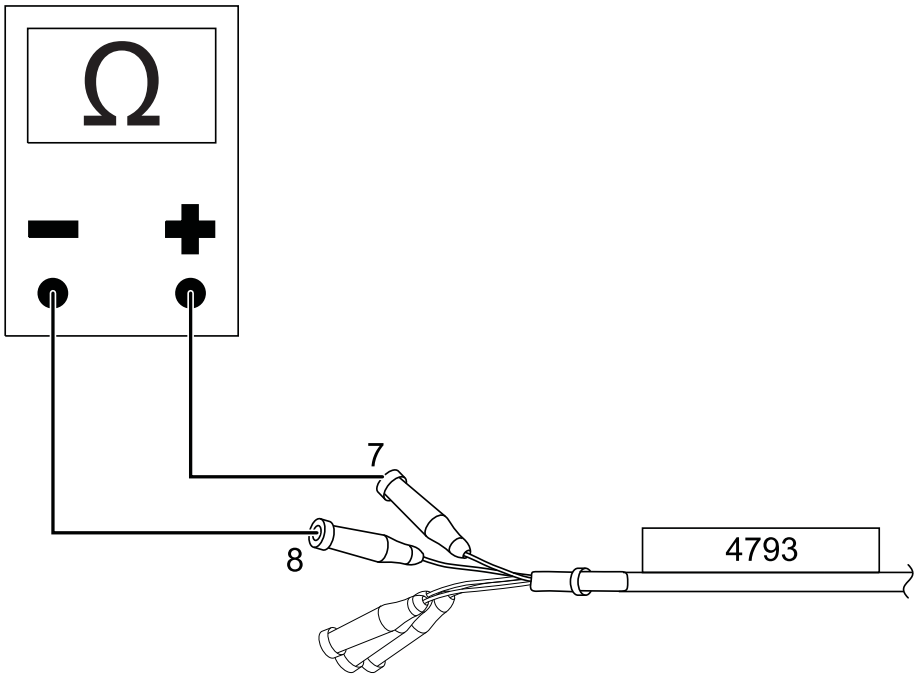


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Figure 634 Test 17 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 17 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 17	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 18.
	No: Go to Test 19.



0000326401

Figure 635 Test 18 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 18 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 18	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and pin-8.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in injector 6 Open coil circuit. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 2798 FMI 6.

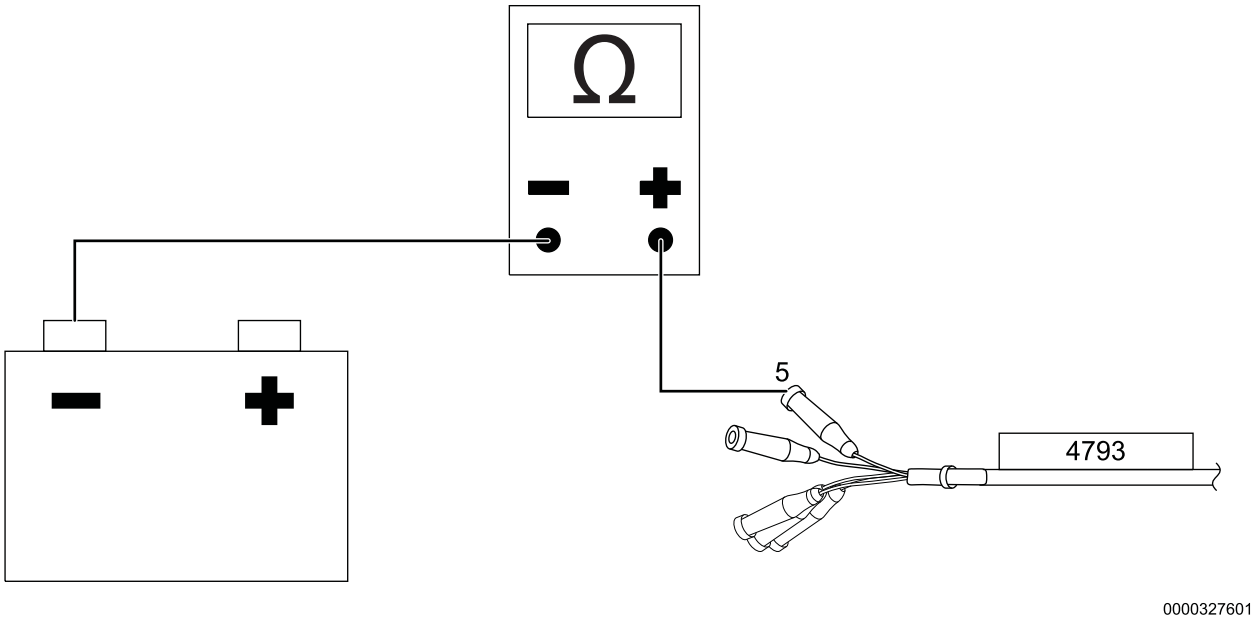


Figure 636 Test 19 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 19 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 19	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 20.
	No: Repair short to GND between Injector 4 pin-5 and ECM Driver pin D-36. After repairs are complete, retest for SPN 2798 FMI 6.

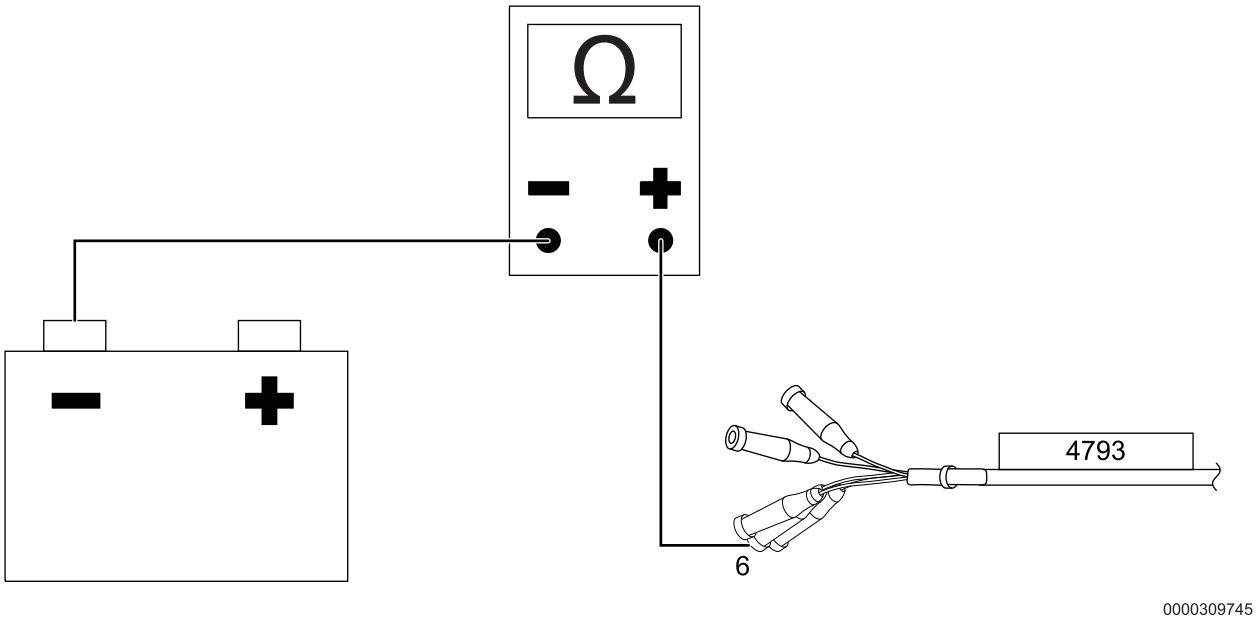


Figure 637 Test 20 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 20 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 20	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 21.
	No: Repair short to GND between Injector 4 pin-6 and ECM Driver pin D-35. After repairs are complete, retest for SPN 2798 FMI 6.

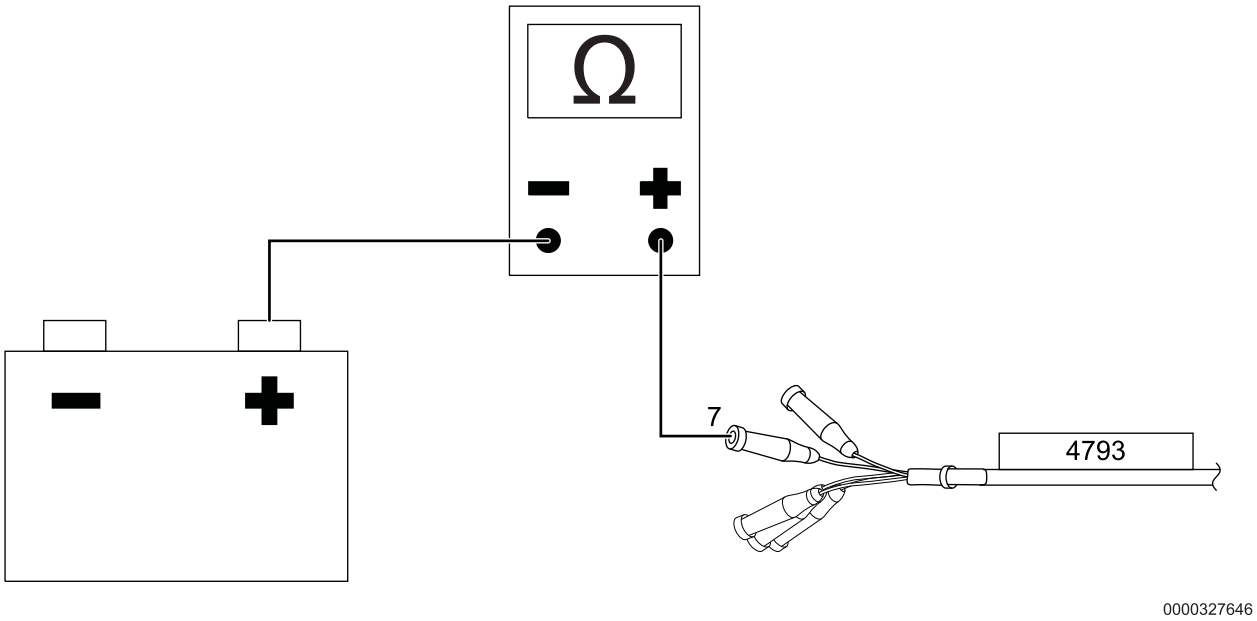


Figure 638 Test 21 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 21 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 21	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 22.
	No: Repair short to GND between Injector 4 pin-7 and ECM Driver pin D-29. After repairs are complete, retest for SPN 2798 FMI 6.

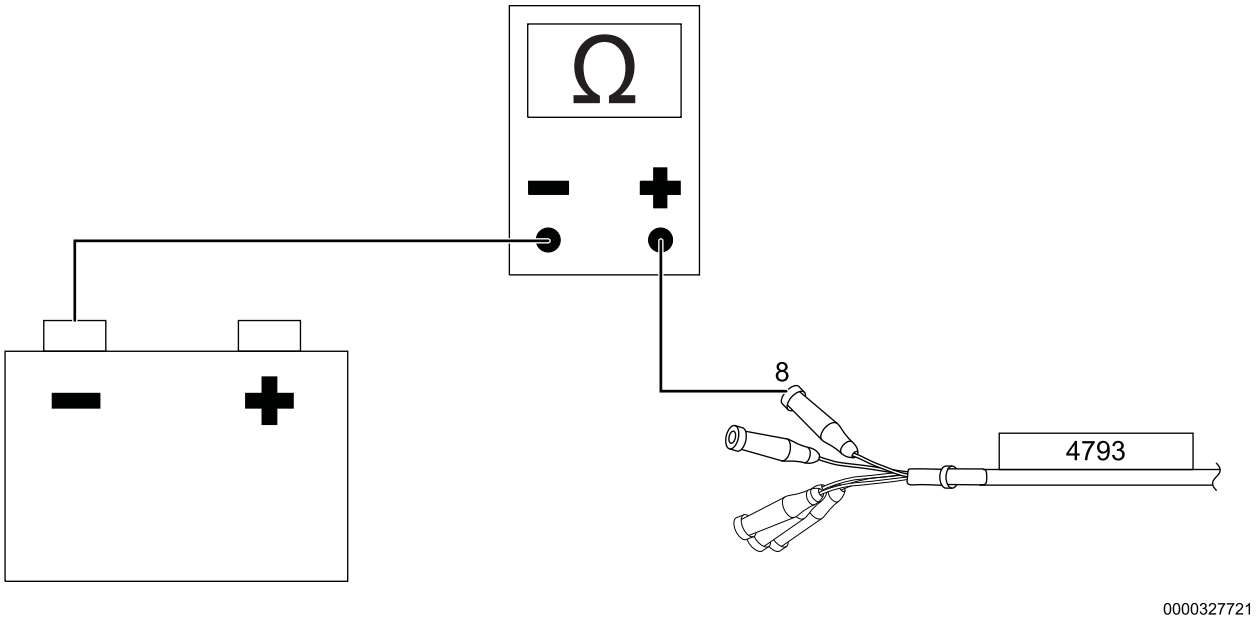


Figure 639 Test 22 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 22 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 22	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 23.
	No: Repair short to GND between Injector 4 pin-8 and ECM Driver pin D-30. After repairs are complete, retest for SPN 2798 FMI 6.

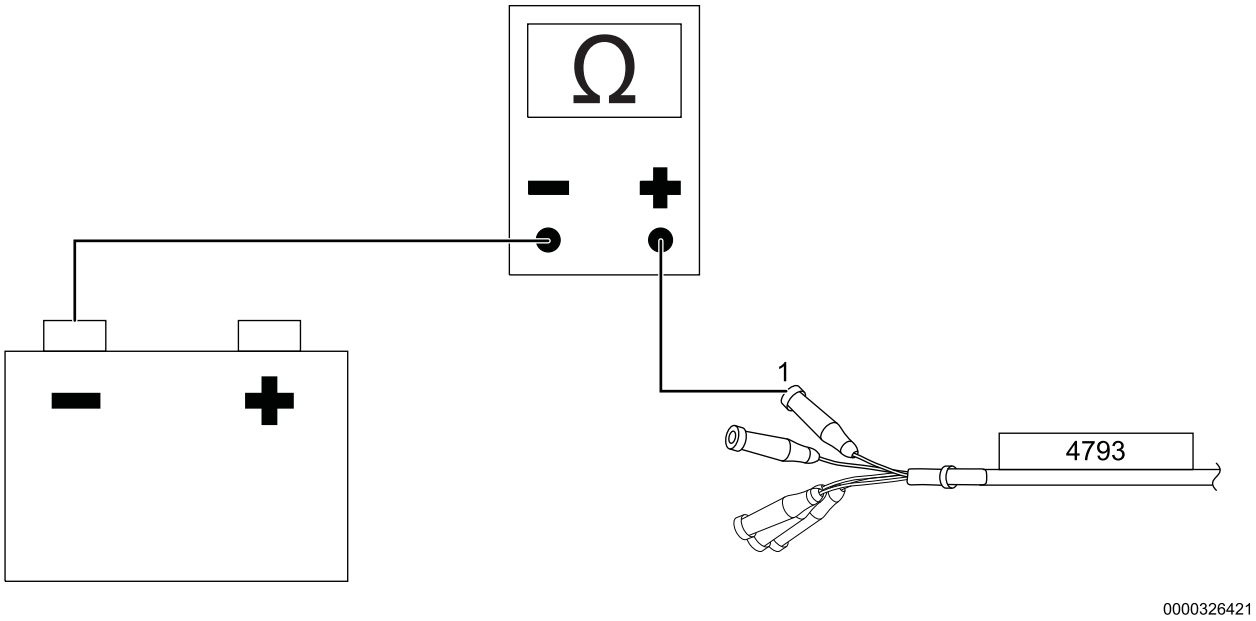


Figure 640 Test 23 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 23 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 23	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 24.
	No: Repair short to GND between Injector 5 pin-1 and ECM Driver pin D-32. After repairs are complete, retest for SPN 2798 FMI 6.

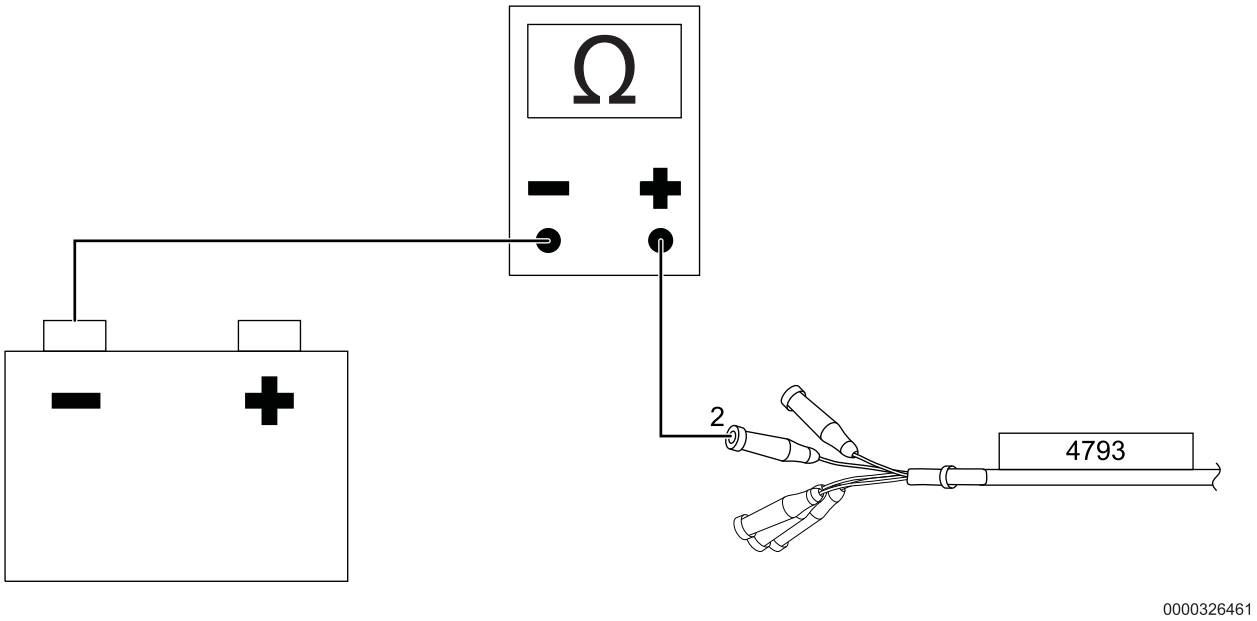


Figure 641 Test 24 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 24 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 24	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 25.
	No: Repair short to GND between Injector 5 pin-2 and ECM Driver pin D-31. After repairs are complete, retest for SPN 2798 FMI 6.

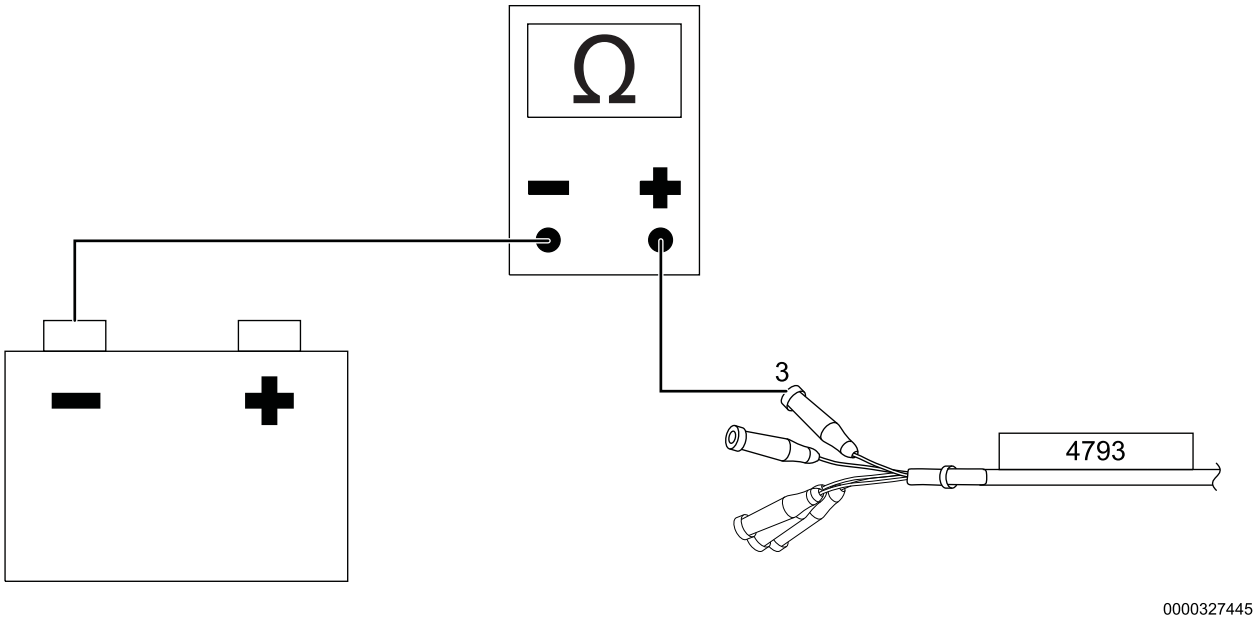


Figure 642 Test 25 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 25 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 25	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 26.
	No: Repair short to GND between Injector 5 pin-3 and ECM Driver pin D-25. After repairs are complete, retest for SPN 2798 FMI 6.

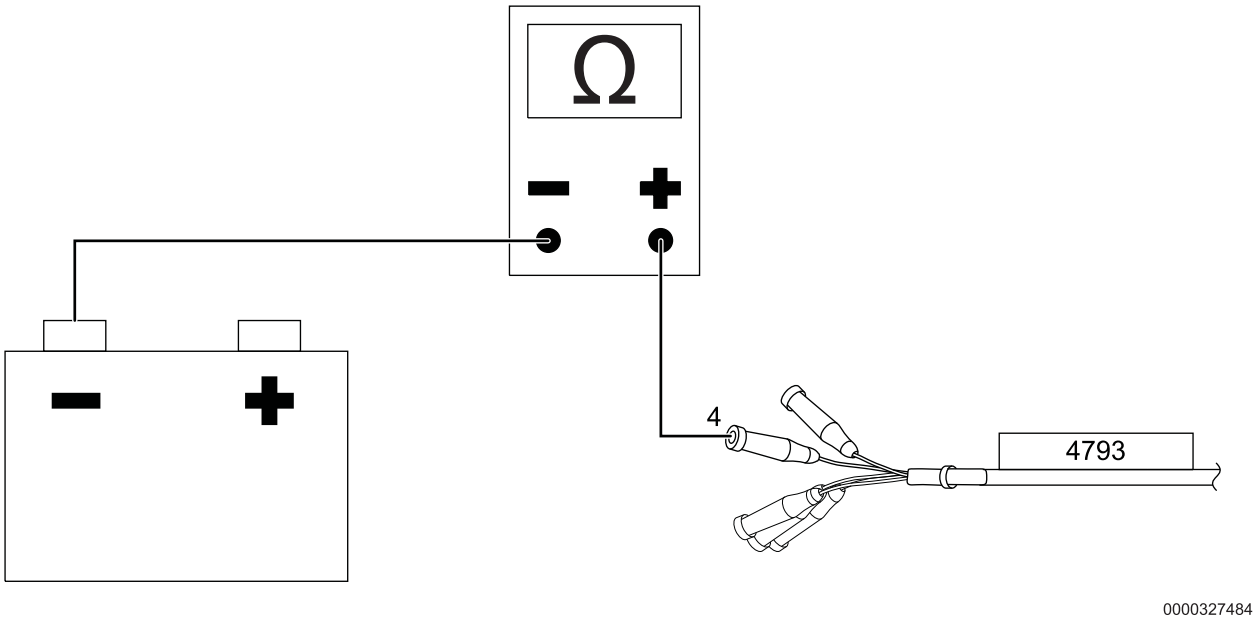


Figure 643 Test 26 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 26 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 26	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 27.
	No: Repair short to GND between Injector 5 pin-4 and ECM Driver pin D-26. After repairs are complete, retest for SPN 2798 FMI 6.

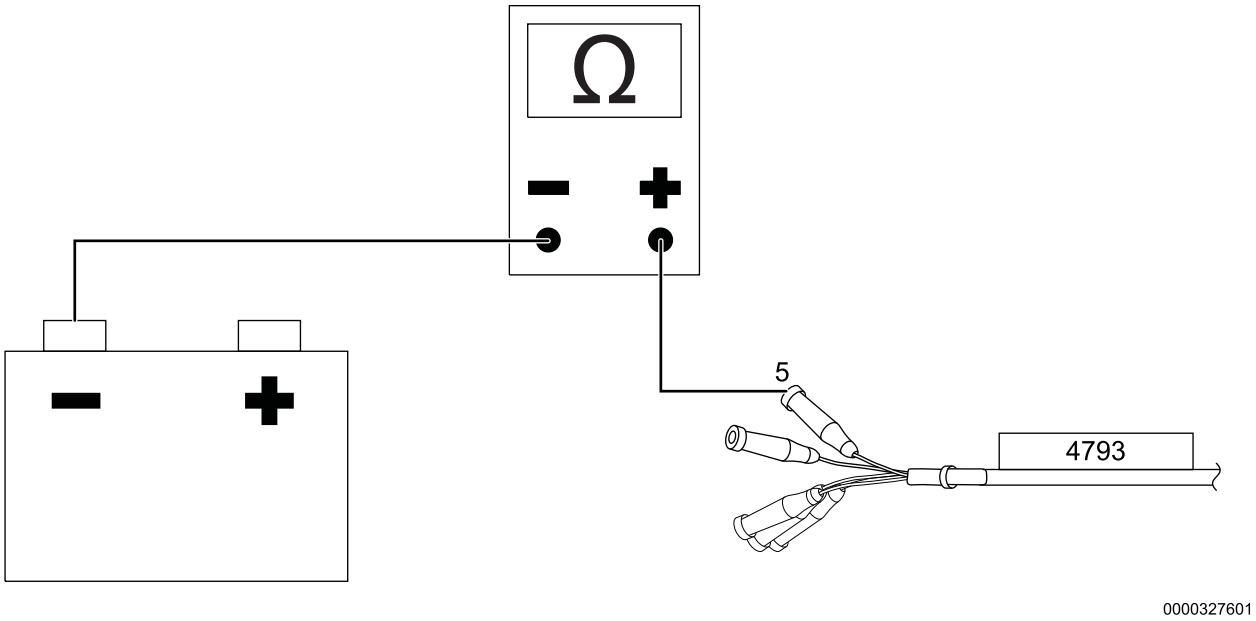


Figure 644 Test 27 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 27 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 27	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 28.
	No: Repair short to GND between Injector 6 pin-5 and ECM Driver pin D-34. After repairs are complete, retest for SPN 2798 FMI 6.

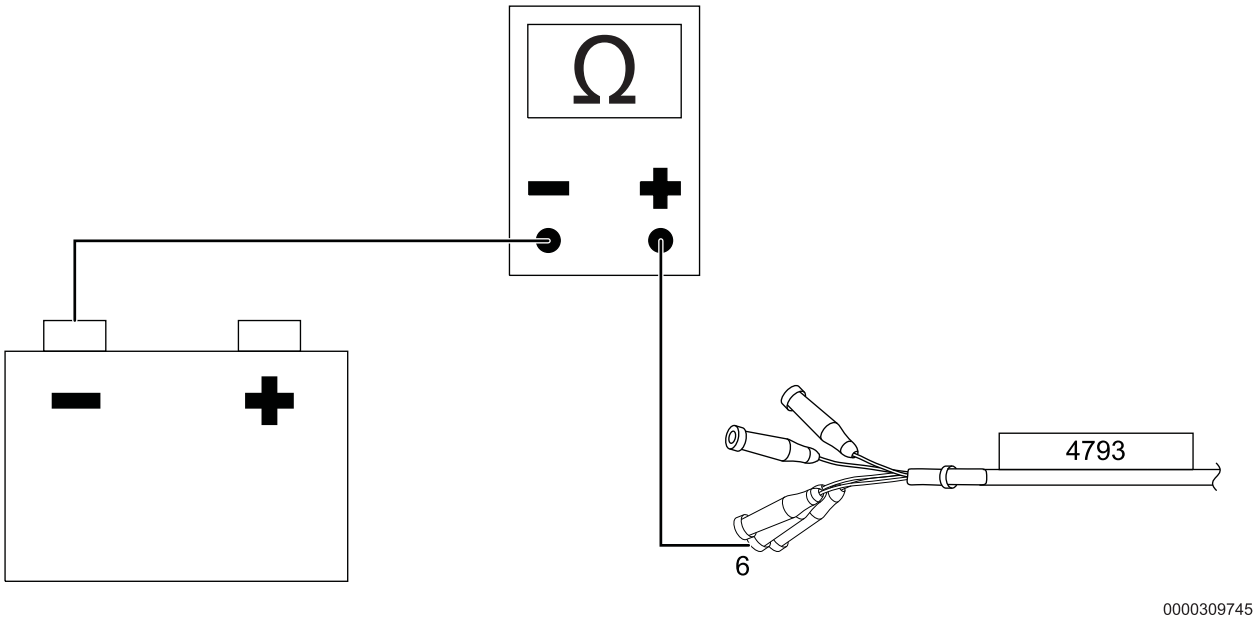


Figure 645 Test 28 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 28 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 28	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 29.
	No: Repair short to GND between Injector 6 pin-6 and ECM Driver pin D-33. After repairs are complete, retest for SPN 2798 FMI 6.

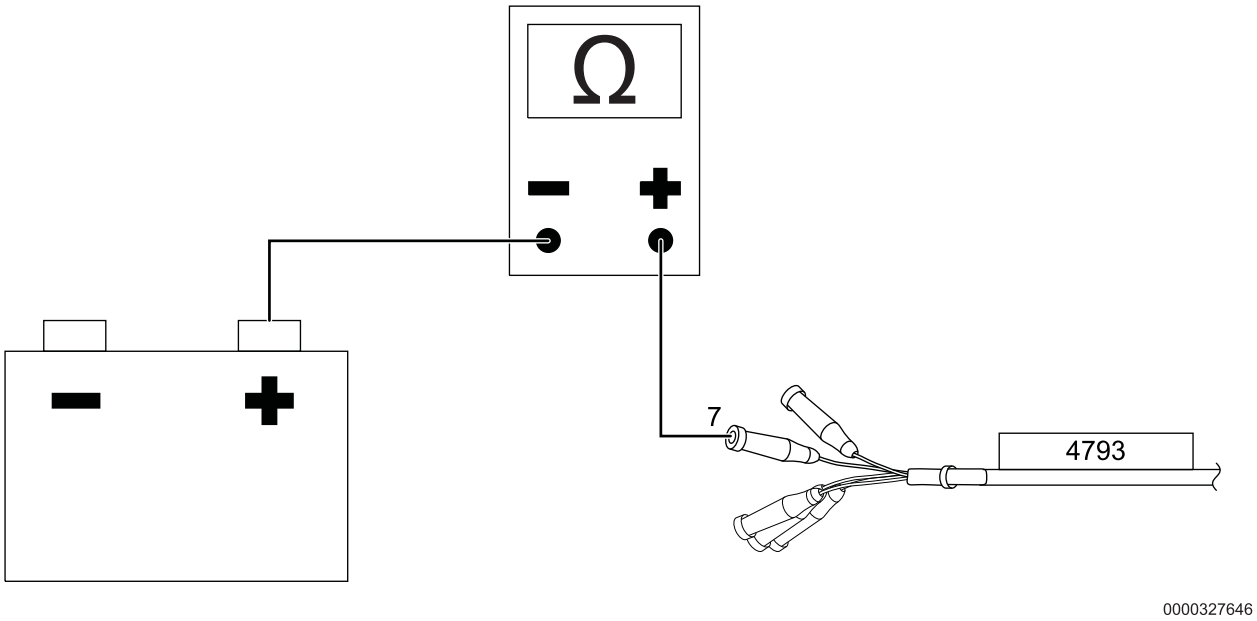


Figure 646 Test 29 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 29 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 29	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 30.
	No: Repair short to GND between Injector 6 pin-7 and ECM Driver pin D-27. After repairs are complete, retest for SPN 2798 FMI 6.

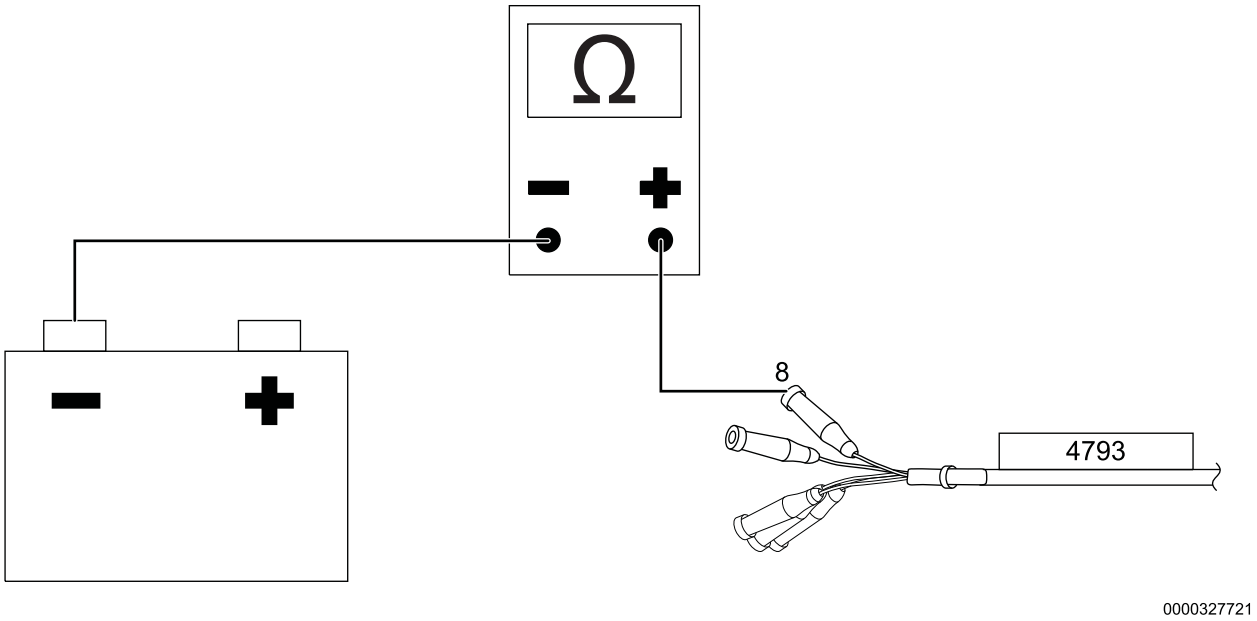


Figure 647 Test 30 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 30 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 30	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 31.
	No: Repair short to GND between Injector 6 pin-8 and ECM Driver pin D-28. After repairs are complete, retest for SPN 2798 FMI 6.

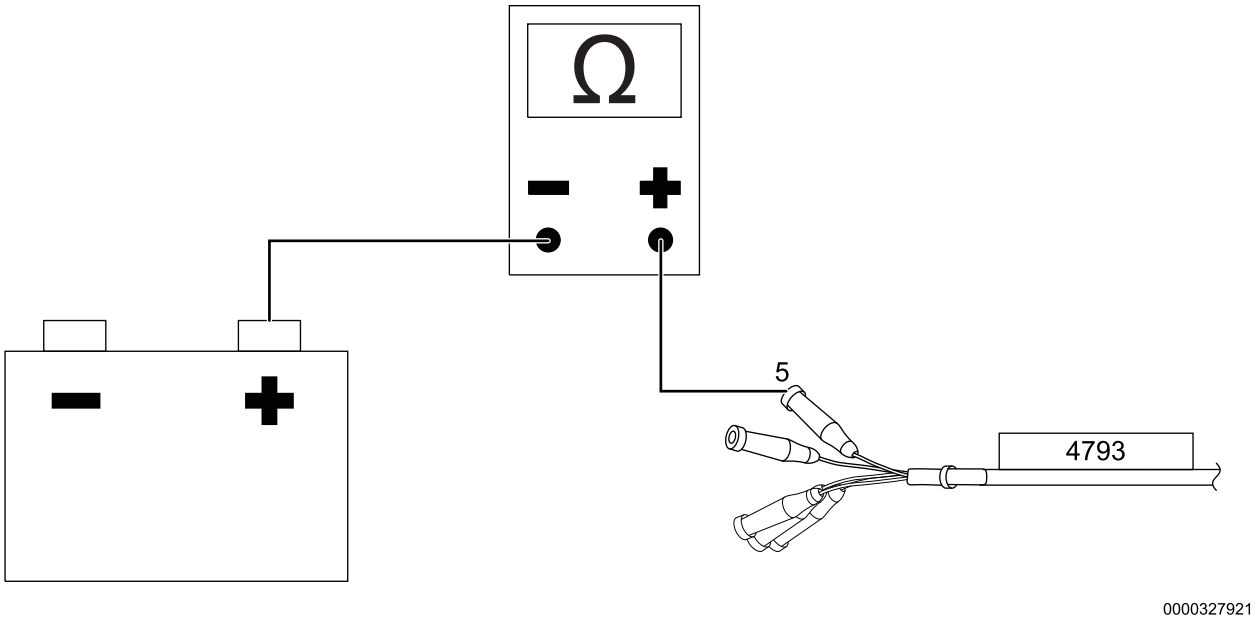


Figure 648 Test 31 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 31 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 31	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 32.
	No: Repair short to PWR between Injector 4 pin-5 and ECM Driver pin D-36. After repairs are complete, retest for SPN 2798 FMI 6.

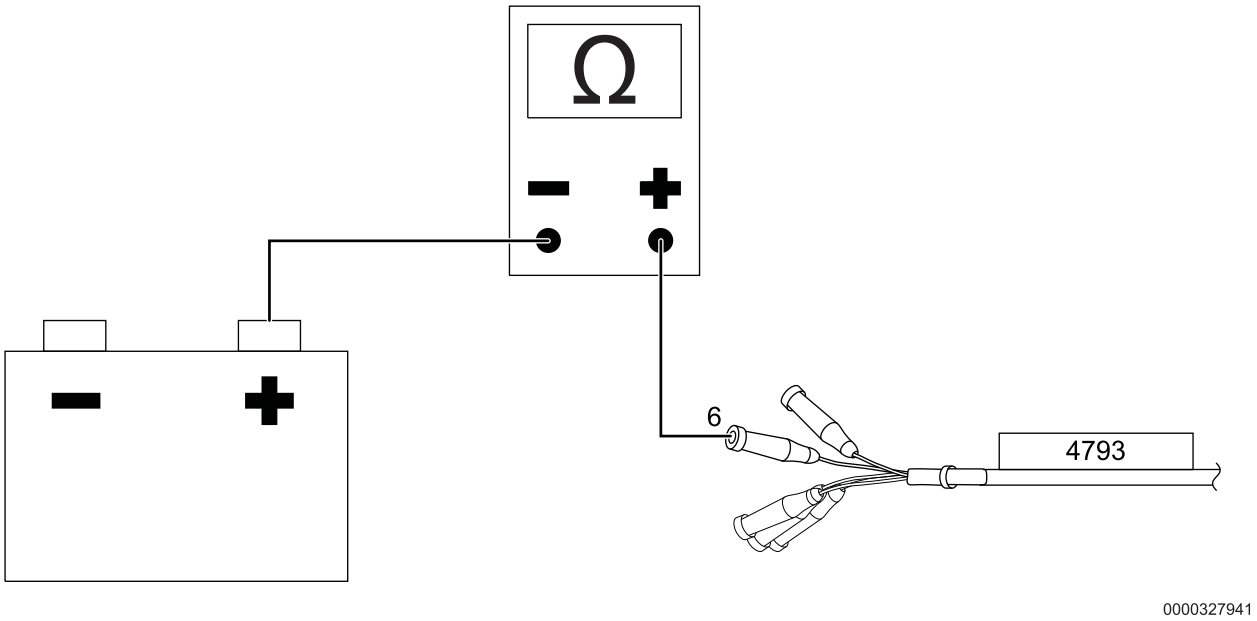


Figure 649 Test 32 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 32 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 32	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 33.
	No: Repair short to PWR between Injector 4 pin-6 and ECM Driver pin D-35. After repairs are complete, retest for SPN 2798 FMI 6.

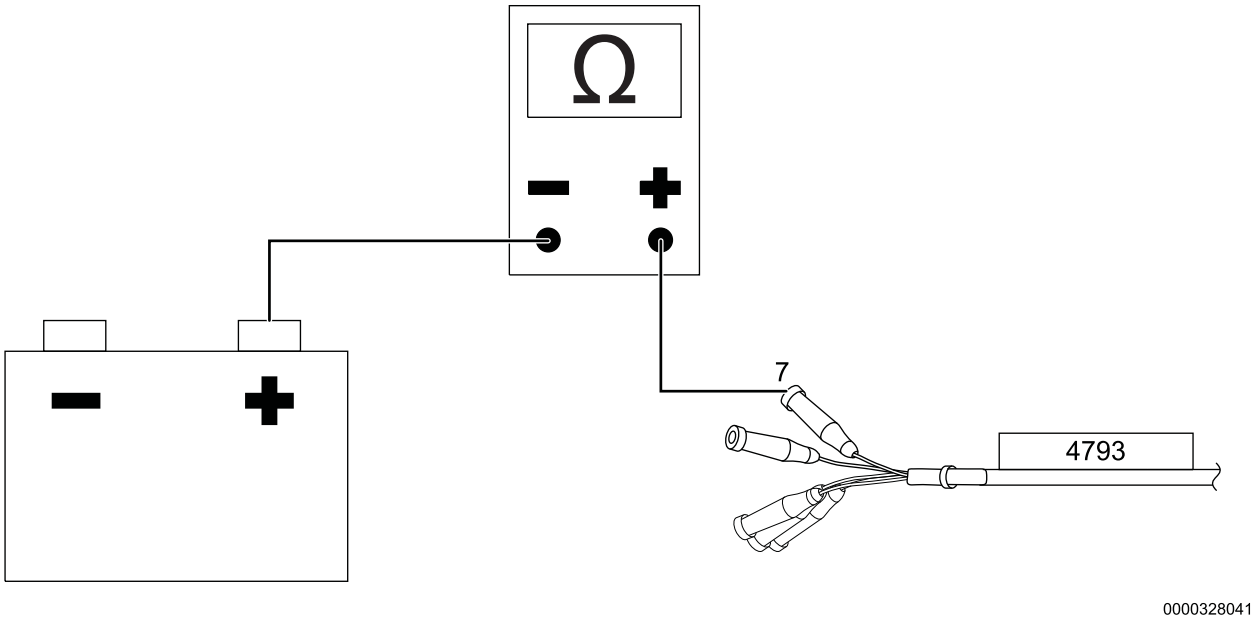


Figure 650 Test 33 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 33 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 33	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 34.
	No: Repair short to PWR between Injector 4 pin-7 and ECM Driver pin D-29. After repairs are complete, retest for SPN 2798 FMI 6.

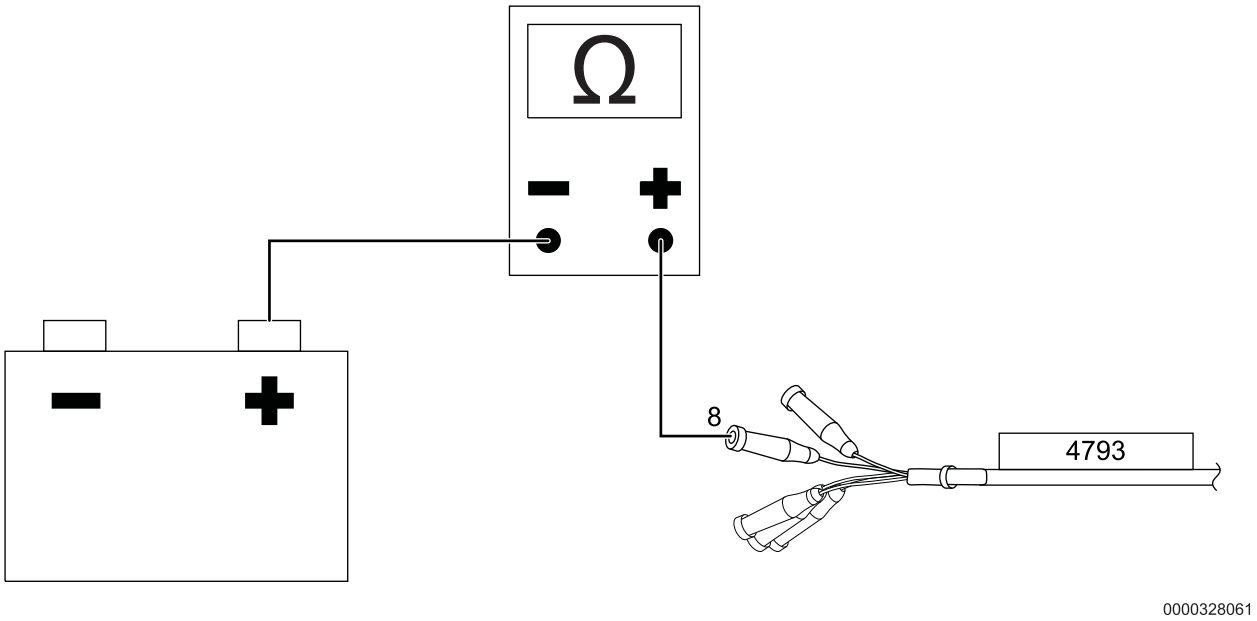


Figure 651 Test 34 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 34 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 34	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-8 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 35.
	No: Repair short to PWR between Injector 4 pin-8 and ECM Driver pin D-30. After repairs are complete, retest for SPN 2798 FMI 6.

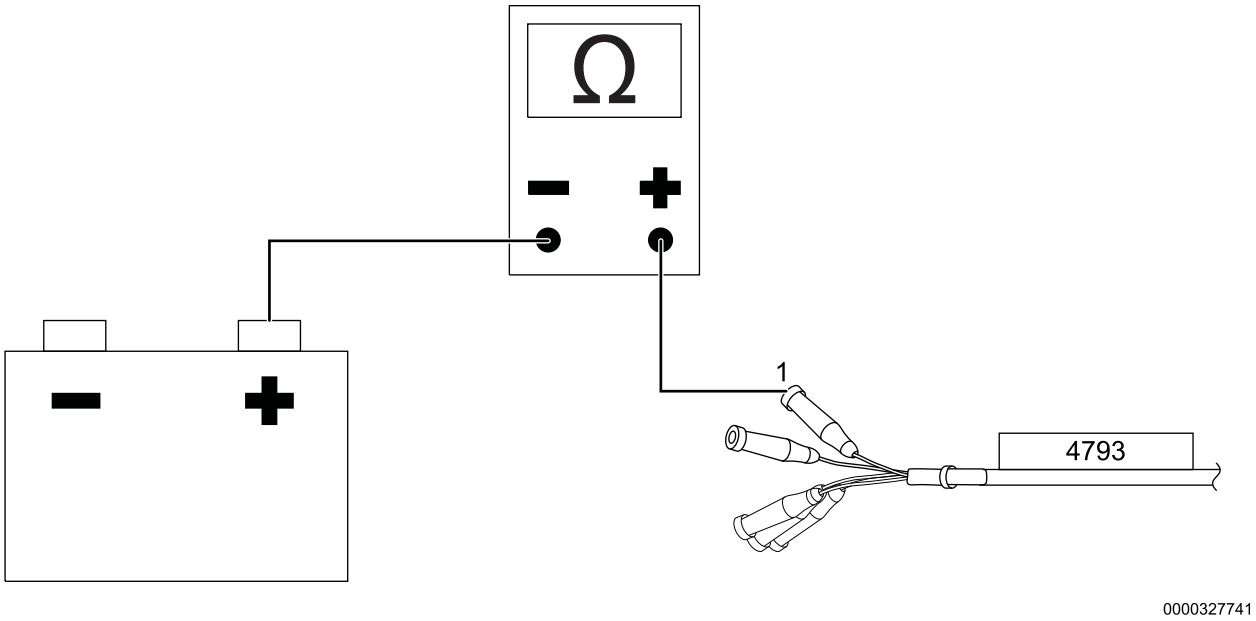


Figure 652 Test 35 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 35 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 35	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 36.
	No: Repair short to PWR between Injector 5 pin-1 and ECM Driver pin D-32. After repairs are complete, retest for SPN 2798 FMI 6.

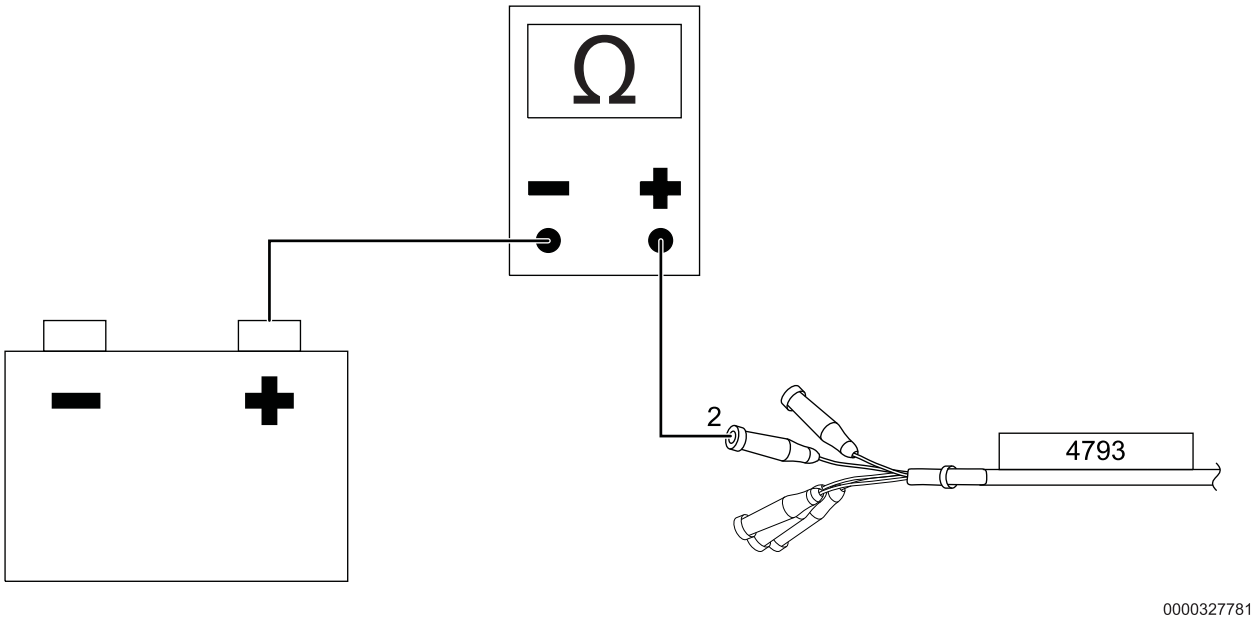


Figure 653 Test 36 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 36 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 36	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 36.
	No: Repair short to PWR between Injector 5 pin-2 and ECM Driver pin D-31. After repairs are complete, retest for SPN 2798 FMI 6.

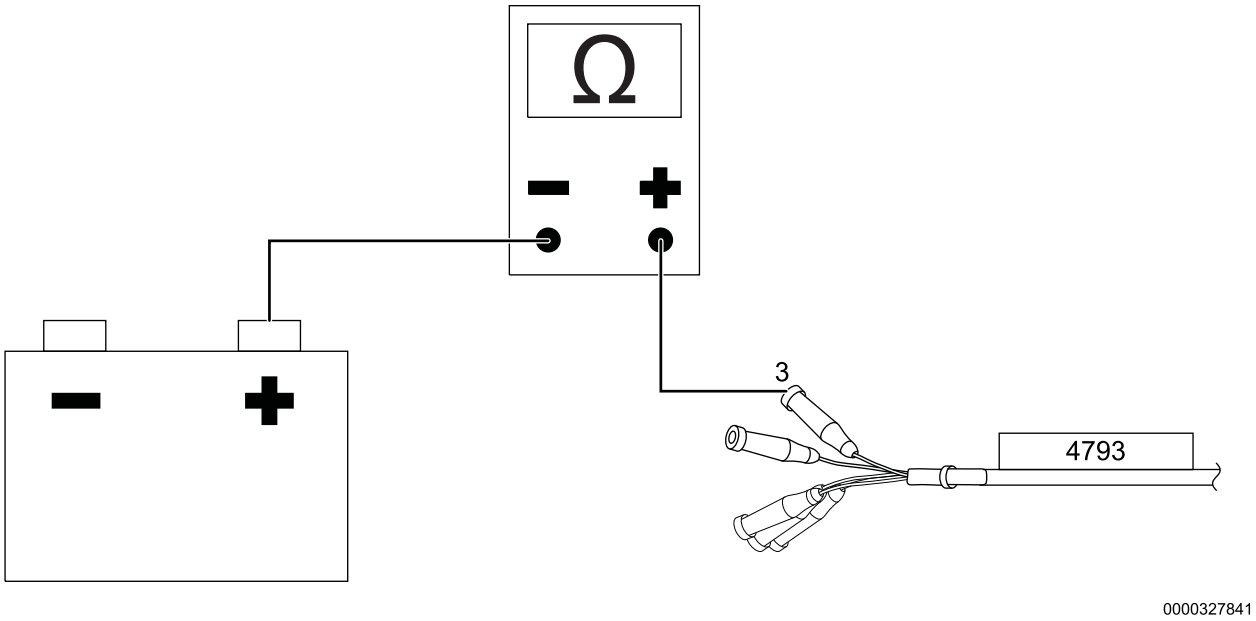


Figure 654 Test 37 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 37 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 37	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-3 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 38.
	No: Repair short to PWR between Injector 5 pin-3 and ECM Driver pin D-25. After repairs are complete, retest for SPN 2798 FMI 6.

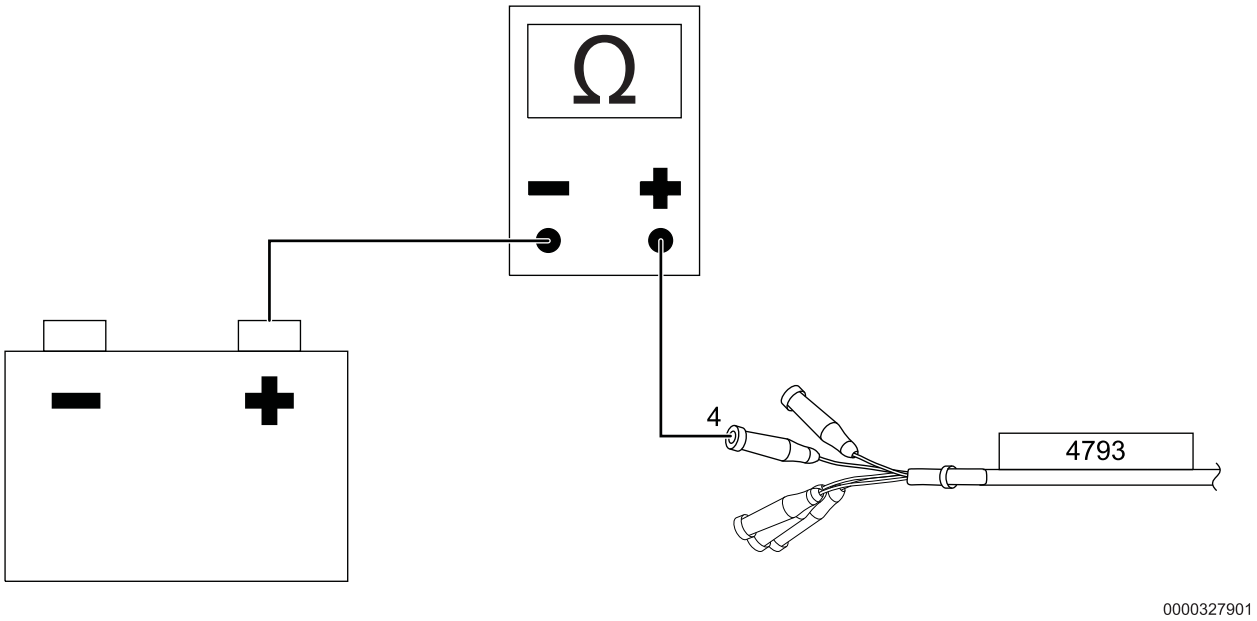


Figure 655 Test 38 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 38 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 38	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-4 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 39.
	No: Repair short to PWR between Injector 5 pin-4 and ECM Driver pin D-26. After repairs are complete, retest for SPN 2798 FMI 6.

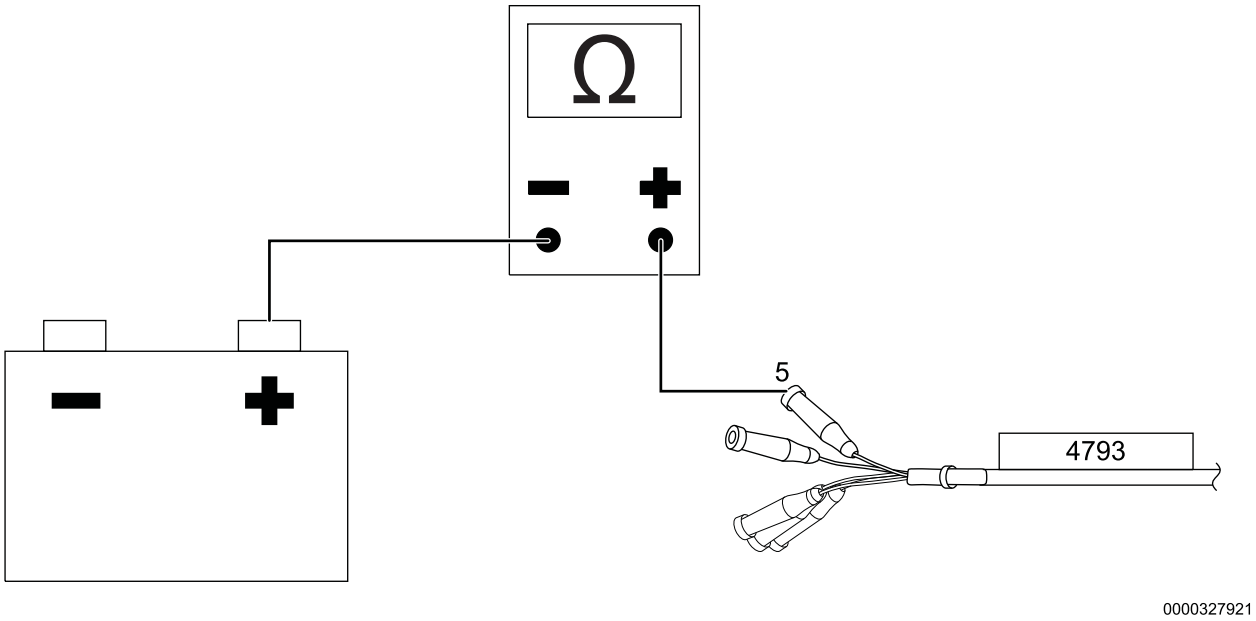


Figure 656 Test 39 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 39 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 39	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 40.
	No: Repair short to PWR between Injector 6 pin-5 and ECM Driver pin D-34. After repairs are complete, retest for SPN 2798 FMI 6.

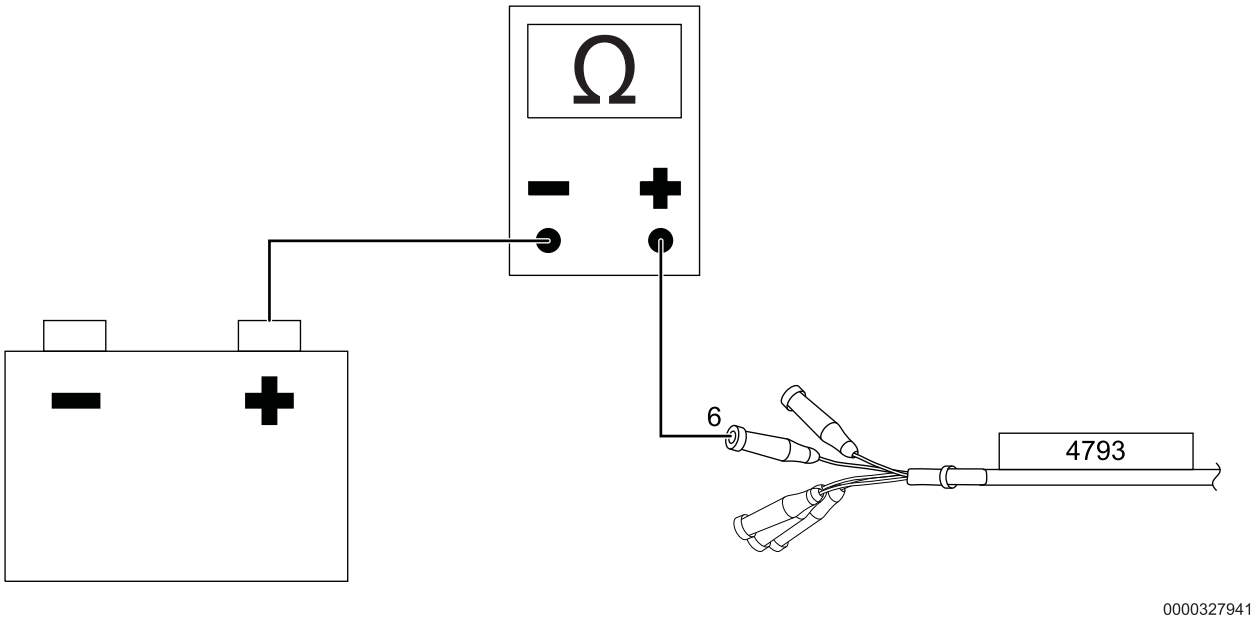


Figure 657 Test 40 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 40 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 40	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 41.
	No: Repair short to PWR between Injector 6 pin-6 and ECM Driver pin D-33. After repairs are complete, retest for SPN 2798 FMI 6.

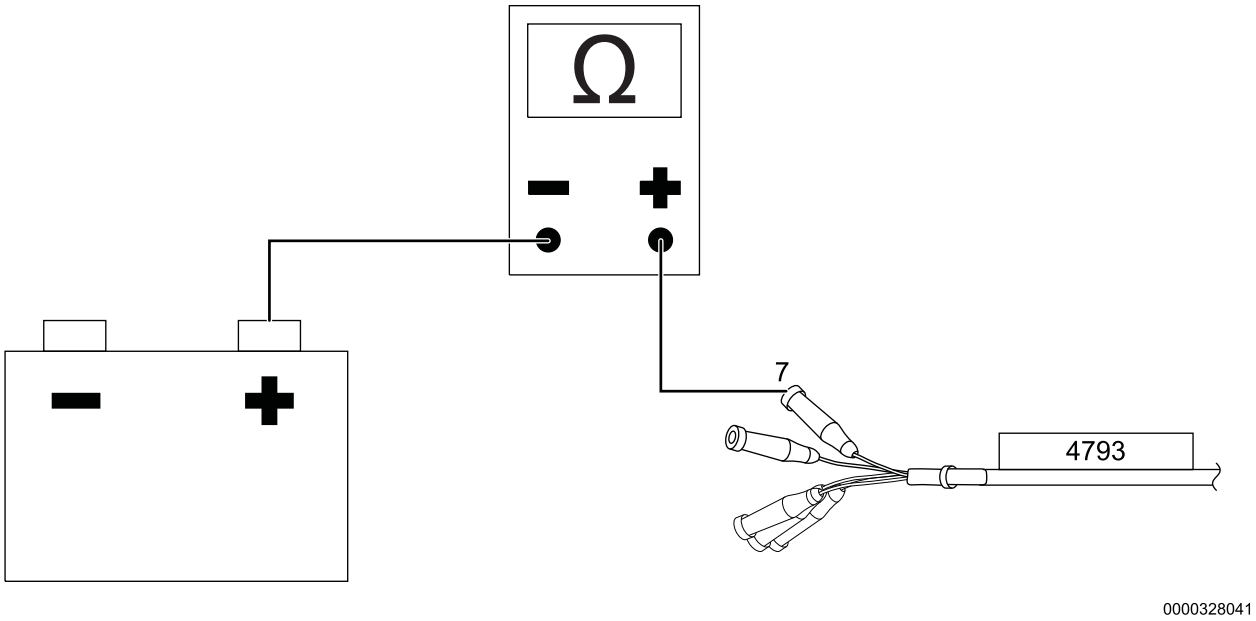


Figure 658 Test 41 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 41 Setup
A. Key OFF. B. Remove valve cover, disconnect Injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 41	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-7 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR between UVC connector 4 pin-4 and ECM Driver pin D-26. After repairs are complete, retest for SPN 2798 FMI 6.
	No: Repair short to PWR between Injector 6 pin-7 and ECM Driver pin D-27. After repairs are complete, retest for SPN 2798 FMI 6.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 2798 FMI 6 fault code diagnostics.

SPN 3055 FMI 2 - ICP / IPR Adaptation In-Range Fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Fuel System Injection Pressure Control Valve adaptation monitor - High and Low	Engine Fuel System Injection Pressure Control Valve adaptation value < -20% OR > 20%	Fuel gradient threshold (Instantaneous difference between two consecutive fuel pressure data points) < 0.248 mg/stroke Engine speed gradient threshold < 100 RPM/second Engine Speed > 30 RPM Time after engine start > 30 seconds Engine Coolant temperature > 104°F (40°C) Maximum allowed rail pressure deviation during injection control pressure valve adaptation as defined by [Table A074] and per time period ≥ 1 second Time since last successful adaptation > 30 seconds Adaptation set points defined by [Table A075] Injection Control Valve Pressure mode enabled

Fault Overview

Fault code sets when fuel system Injection Pressure Control Valve adaptation value exceeds threshold values immediately.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

• SPN 164 FMI 3 and 4 (ICP)	• SPN 679 FMI 3 and 4 (IPR)		

Fault Facts

This fault can set if a high-pressure oil system repair was completed and the "Fuel Pressure Adaptation Reset" procedure was not performed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel Pressure Adaptation Reset procedure was not performed after high-pressure oil system repairs
- High-pressure oil system repair is necessary

Step 1	Check for associated fault codes.	**Decision**
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check DTC list for Associated Faults(page 1657). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3055 FMI 2.

Step 2	Check for active fault during engine cranking.	**Decision**
Monitor Diagnostic Trouble Code (DTC) list while attempting to start engine. Did SPN 164 FMI 1 fault set while cranking?		Yes: Go to Step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Check for engine oil issues.	Decision
Check engine oil level and condition. Is engine oil at proper level and in good condition?		Yes: Go to Step 4.
		No: Correct / repair engine oil issues. After repairs are complete, retest for SPN 3055 FMI 2.

Step 4	Inspect High-Pressure Oil Pump (HPOP) reservoir to ensure there is enough fluid.	Decision
Check that reservoir has oil in it. Remove Engine Oil Temperature (EOT) sensor for observation. Does reservoir have oil in it?		Yes: Reinstall EOT sensor and then go to Step 5.
		No: Diagnose / repair lubrication system. After repairs are complete, retest for SPN 3055 FMI 2.

Step 5	Check High-Pressure Oil Pump (HPOP) Injection Pressure Regulator (IPR) electrical circuit.	Decision
Inspect IPR valve electrical circuit by connecting Cylinder Performance Analyzer (CPA) tool(page 2197) to engine and perform CPA HPOP test(page 2227). Is there a detected issue with IPR valve electrical circuit?		Yes: Diagnose / repair electrical circuit for the IPR valve. After repairs are complete, retest for SPN 3055 FMI 2. No: Go to Step 6.

Step 6	Mechanically test Injection Pressure Regulator (IPR) valve hydraulic circuit.	Decision
Hydraulically block off IPR return path by connecting Cylinder Performance Analyzer (CPA) tool(page 2197) to engine and use IPR Plug Tester(Figure 1148) to bring IPR valve hydraulic circuit under maximum pressure. Is there a detected issue with IPR valve hydraulic circuit?		Yes: Replace IPR valve and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset(page 2117). After repairs are complete, retest for SPN 3055 FMI 2. No: Go to Step 7.

Step 7	Perform dead head test of High-Pressure Oil Pump (HPOP).	Decision
Connect Cylinder Performance Analyzer (CPA) tool(page 2197) to engine and use Pressure Adapter Fitting and ICP Test Kit(Figure 1159) isolating hydraulic system from HPOP to determine if it develops pressure when pump is dead headed. Does this test detect an issue with HPOP pump? **NOTE:** CPA tool has additional capabilities to determine HPOP failure modes, compared to a simple pressure specification.		Yes: Go to Step 8. No: Proceed to Steps 9 through 12.

Step 8	Inspect intake screen.	Decision
Remove High-Pressure Oil Pump (HPOP) pump and inspect intake screen for plugging and debris. Is debris plugging intake to HPOP? **NOTE:** Visual inspection determines whether or not debris on intake side of HPOP is cause of insufficient dead head pressure.		Yes: Clean intake screen (locate and repair source of debris) and perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset(page 2117). After repairs are complete, retest for SPN 3055 FMI 2. No: Replace HPOP and perform KOEO Procedure Fuel Pressure Adaptation Reset(page 2117). After

	repairs are complete, retest for SPN 3055 FMI 2.

Step 9	Inspect injector spool valve.	Decision
Inspect injector spool valve for debris. Is debris present?		Yes: Clean debris and then go to Step 10.
		No: Go to Step 10.

Step 10	Perform Injector Test.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, perform Injector Test (Buzz test)(page 2154) to ensure all injectors function properly. Do all injectors function properly?		Yes: Go to Step 11.
		No: Repair / replace faulty injector(s) and then go to Step 11.

Step 11	Remove and clean injector plumbing.	Decision
Remove and clean high-pressure oil rail, high-pressure oil hose, and elbow connections to remove contamination or debris.		Go to Step 12.

Step 12	Injector replacement and reset.	Decision
Replace all six injectors, pucks, and seals. Perform Key-On Engine-Off (KOEO) Procedure Fuel Pressure Adaptation Reset(page 2117).		Go to End Diagnostic Steps.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3055 FMI 2 fault code diagnostics.

SPN 3659 FMI 4 - Injector 1 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 1 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3659 FMI 4. Is EST DTC list SPN 3659 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

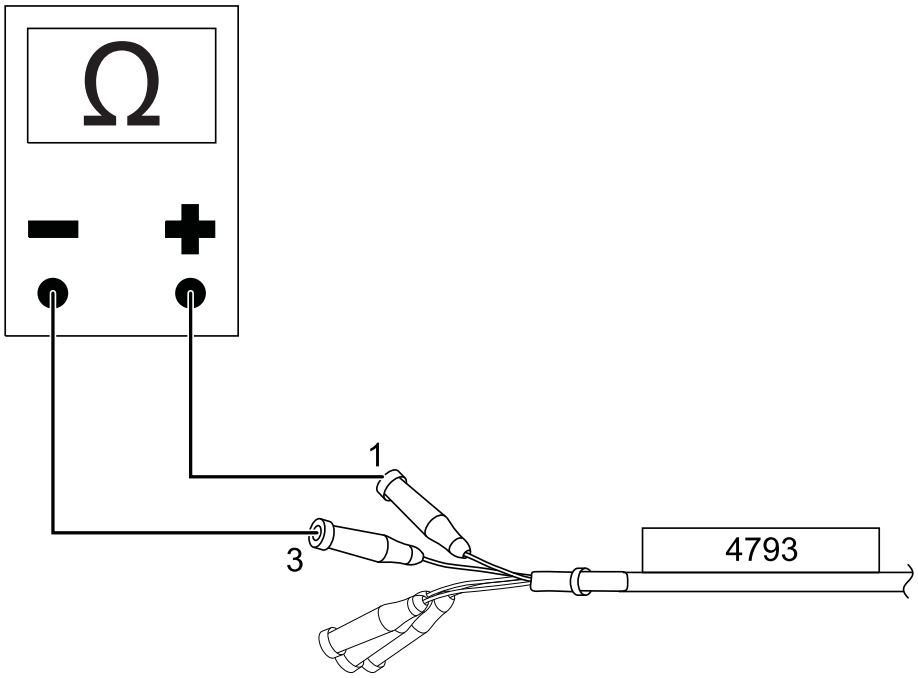
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3659 FMI 4.

Pin-Point Tests (SPN 3659 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

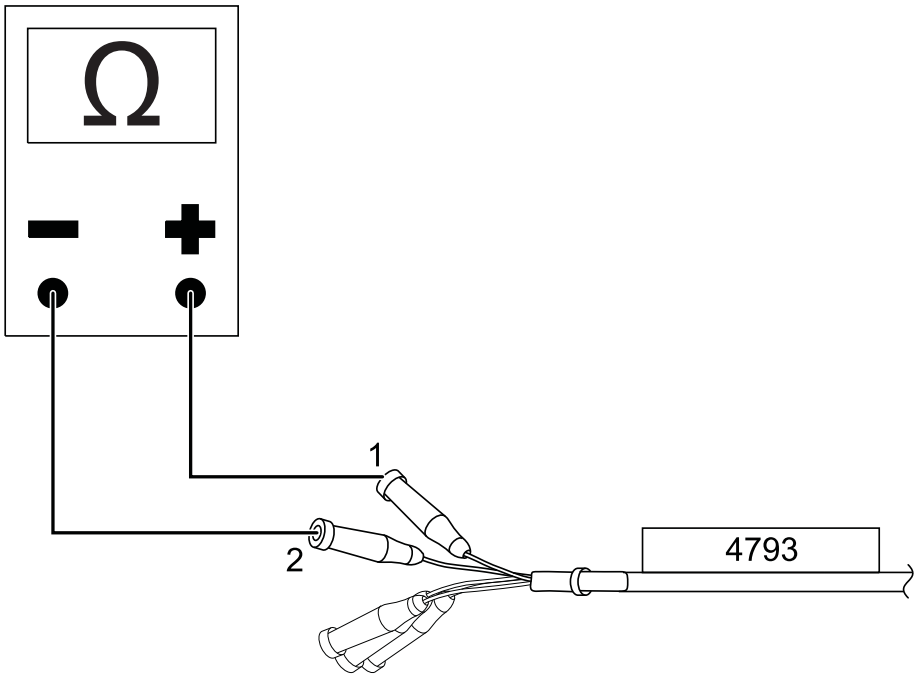


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Figure 659 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 1 Close and fuel injector 1 Open circuit. After repairs are complete, retest for SPN 3659 FMI 4.

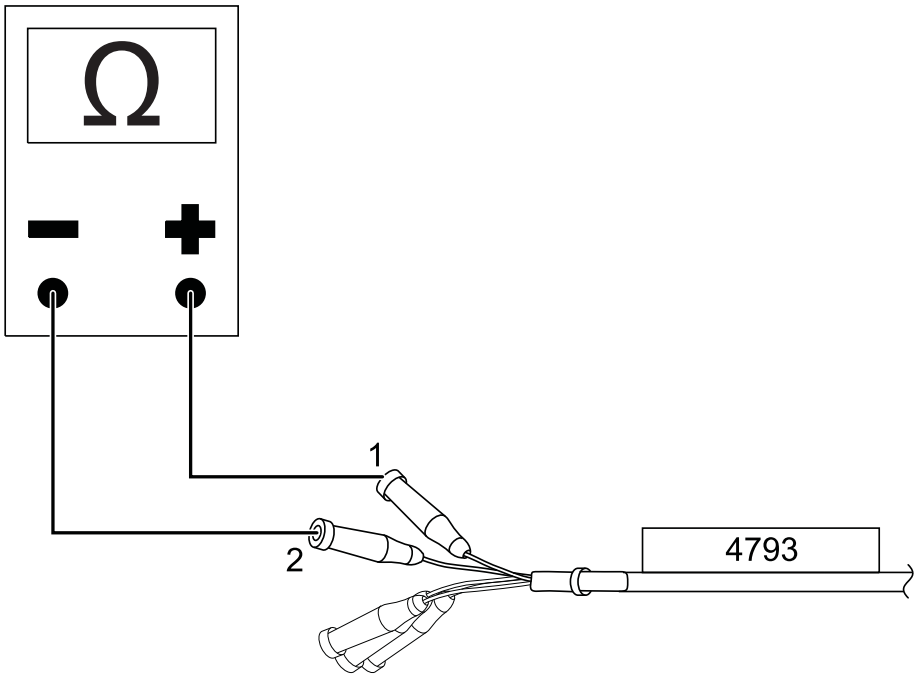


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Figure 660 Test 2 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326341

Figure 661 Test 3 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 1 Close circuit. After repairs are complete, retest for SPN 3659 FMI 4.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 3659 FMI 4.

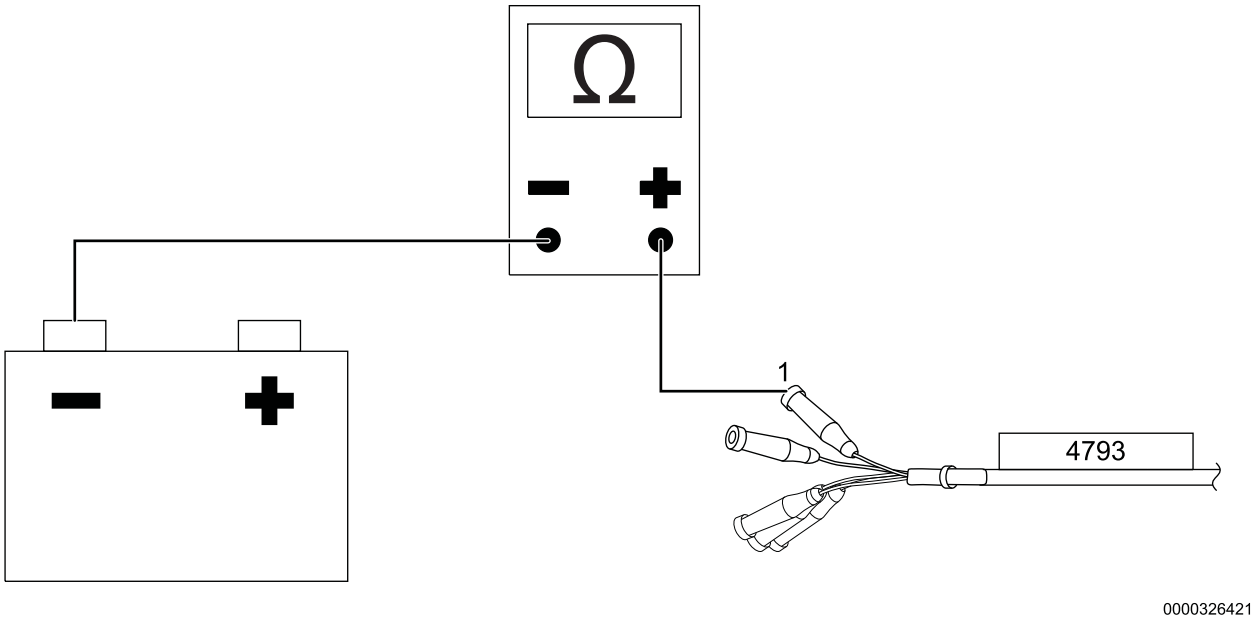


Figure 662 Test 4 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 1 Close H circuit. After repairs are complete, retest for SPN 3659 FMI 4.

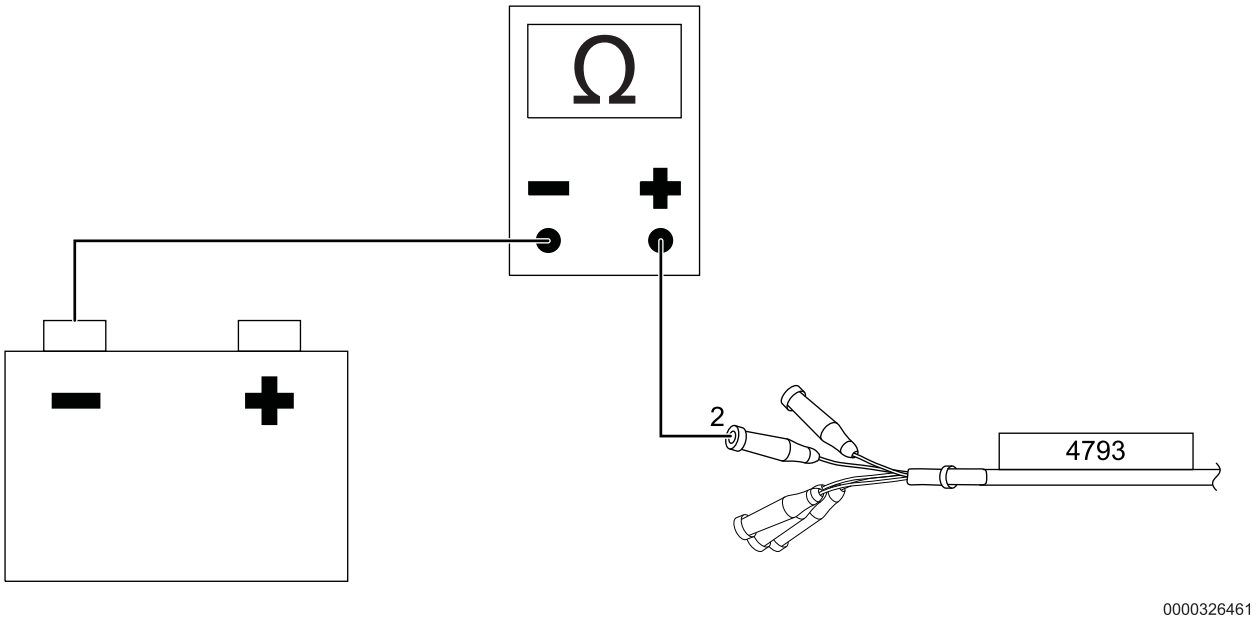


Figure 663 Test 5 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 1 Close L circuit. After repairs are complete, retest for SPN 3659 FMI 4.

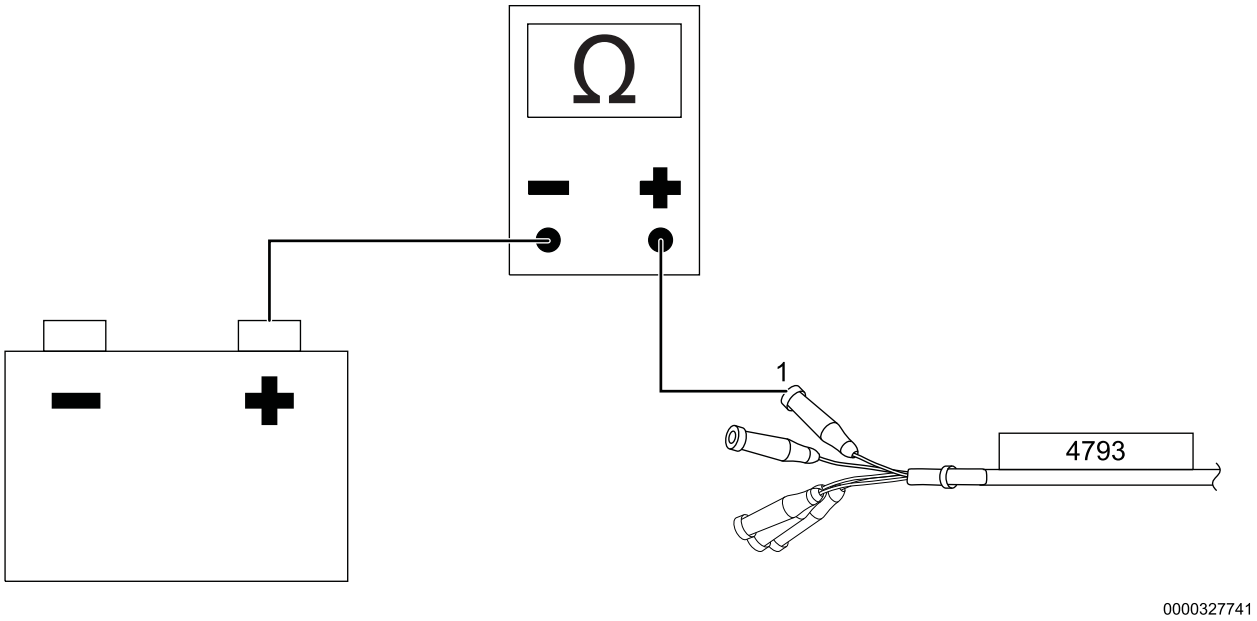


Figure 664 Test 6 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 1. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 1 Close L circuit. After repairs are complete, retest for SPN 3659 FMI 4.
	No: Repair short to PWR in fuel injector 1 Close H circuit. After repairs are complete, retest for SPN 3659 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3659 FMI 4 fault code diagnostics.

SPN 3660 FMI 4 - Injector 2 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 2 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3660 FMI 4. Is EST DTC list SPN 3660 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

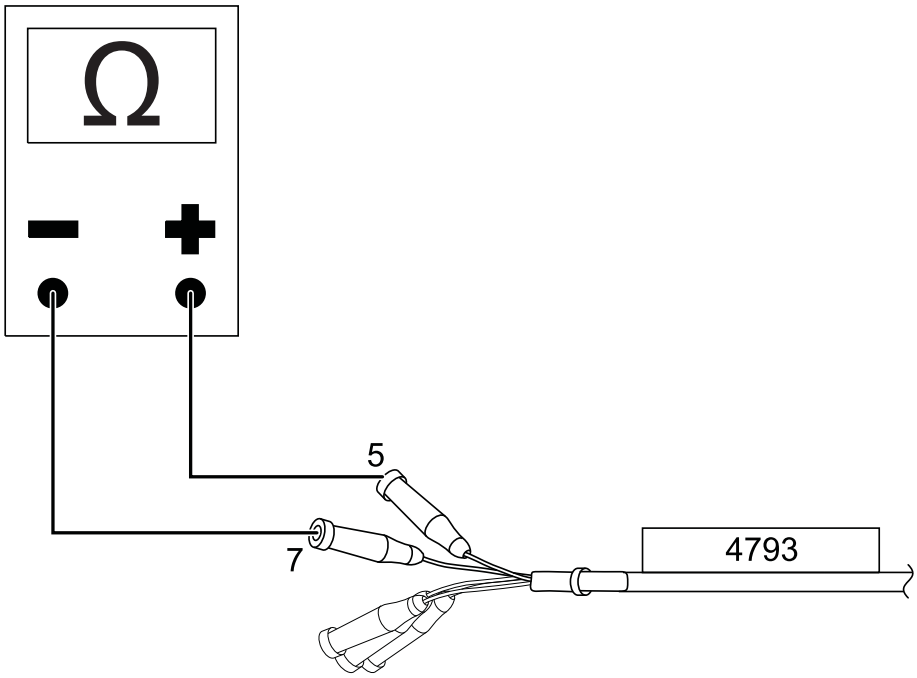
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
A. Key OFF B. Disconnect UVC 2 C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3660 FMI 4.

Pin-Point Tests (SPN 3660 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

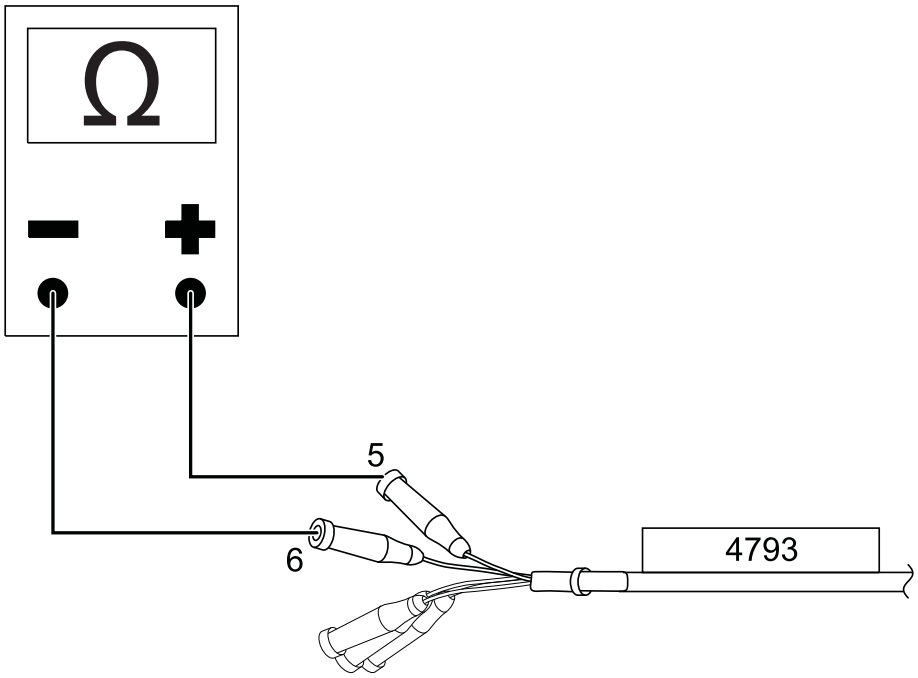


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Figure 665 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 2 Close and fuel injector 2 Open circuit. After repairs are complete, retest for SPN 3660 FMI 4.

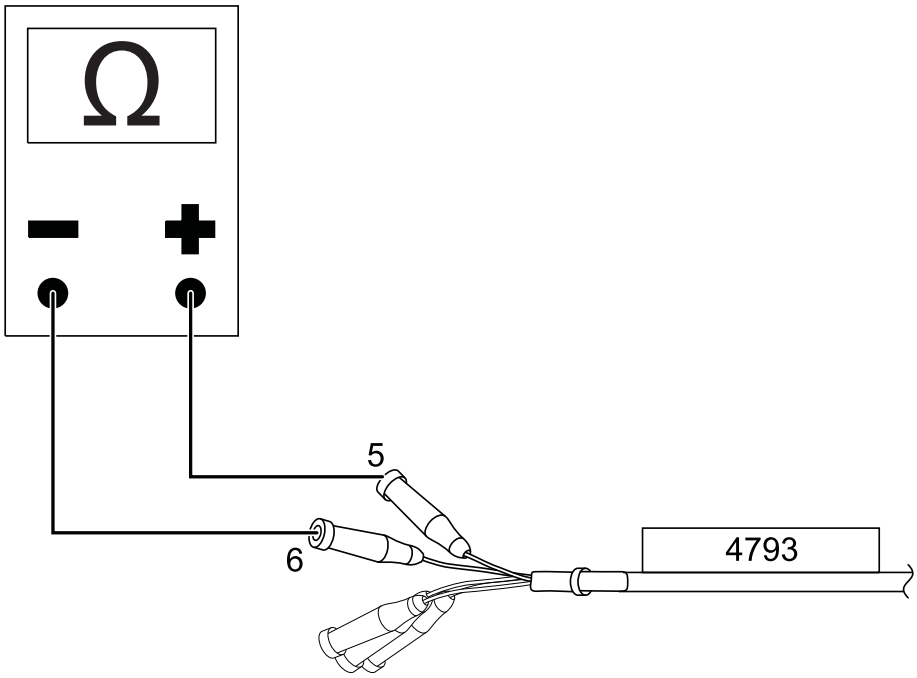


0000326381

Figure 666 Test 2 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326381

Figure 667 Test 3 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 2 Close circuit. After repairs are complete, retest for SPN 3660 FMI 4.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 3660 FMI 4.

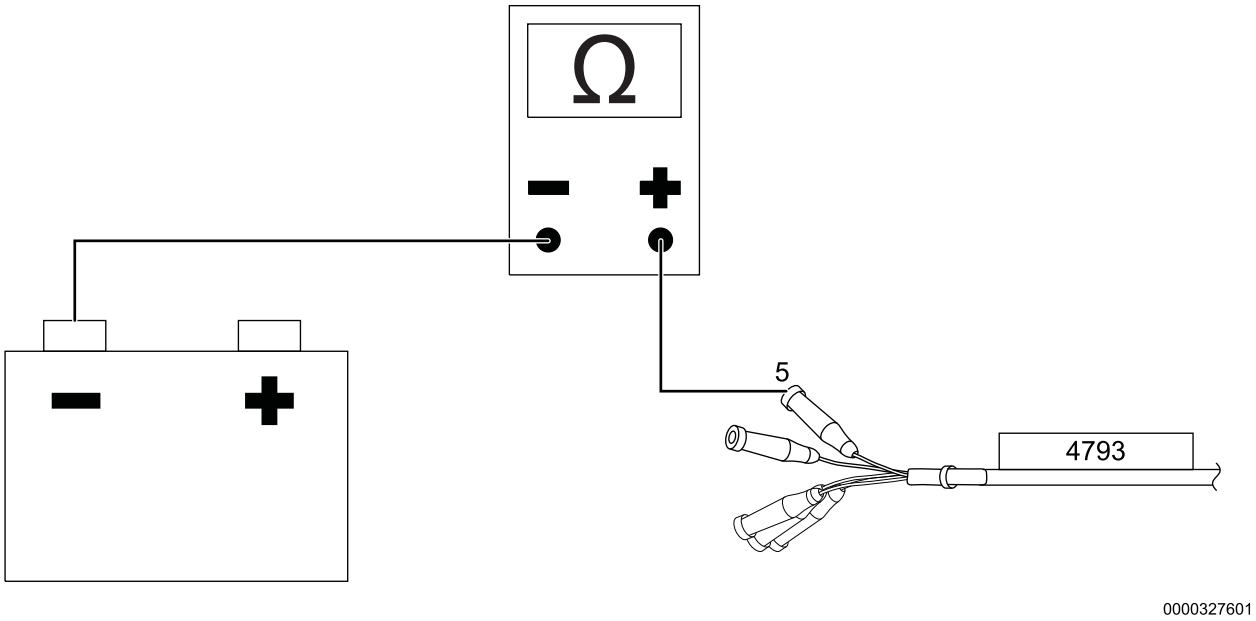


Figure 668 Test 4 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 2 Close H circuit. After repairs are complete, retest for SPN 3660 FMI 4.

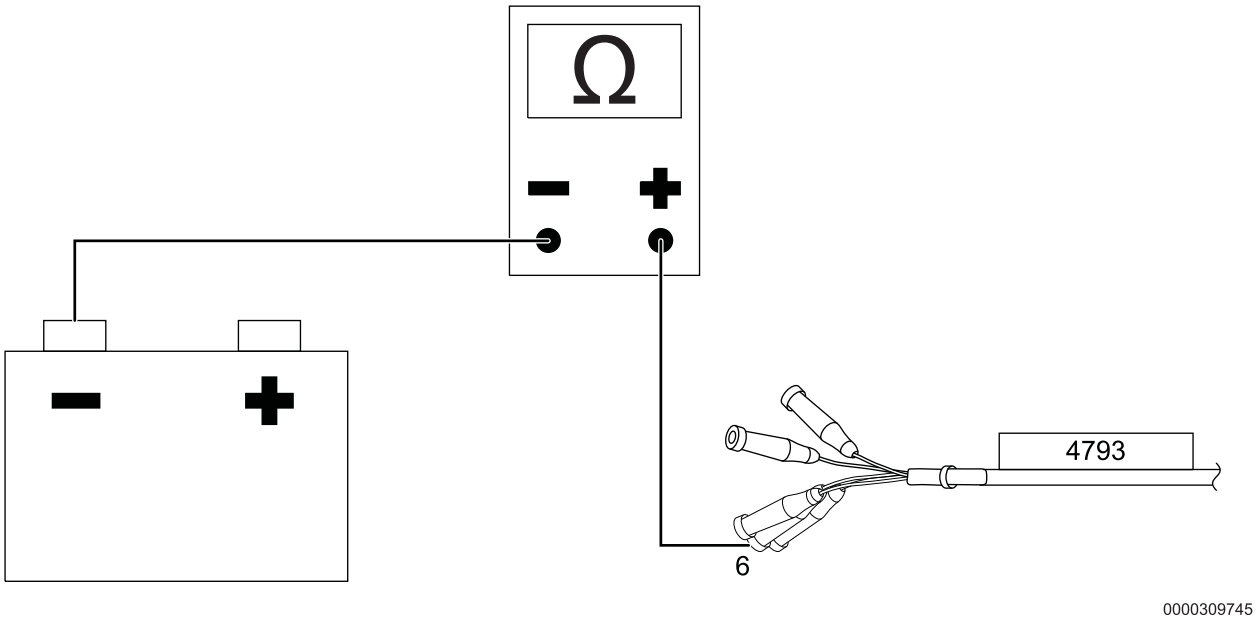


Figure 669 Test 5 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 2 Close L circuit. After repairs are complete, retest for SPN 3660 FMI 4.

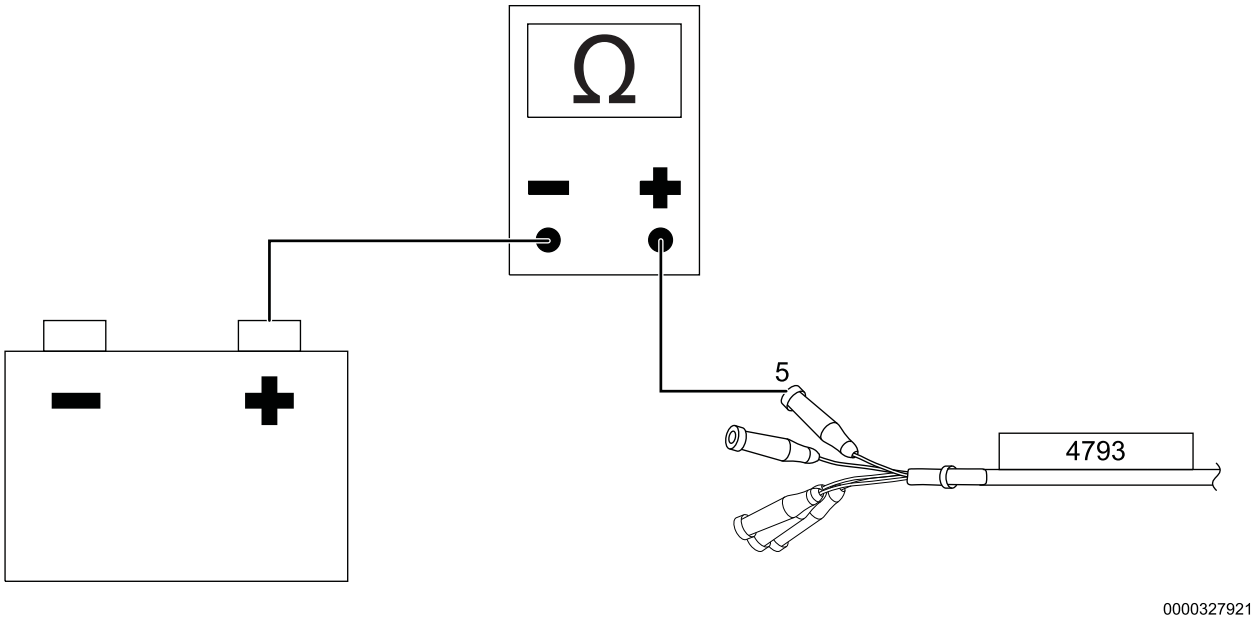


Figure 670 Test 6 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 2. C. Disconnect Under Valve Connector (UVC) connector 2. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 2 Close L circuit. After repairs are complete, retest for SPN 3660 FMI 4.
	No: Repair short to PWR in fuel injector 2 Close H circuit. After repairs are complete, retest for SPN 3660 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3660 FMI 4 fault code diagnostics.

SPN 3661 FMI 4 - Injector 3 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 3 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3661 FMI 4. Is EST DTC list SPN 3661 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

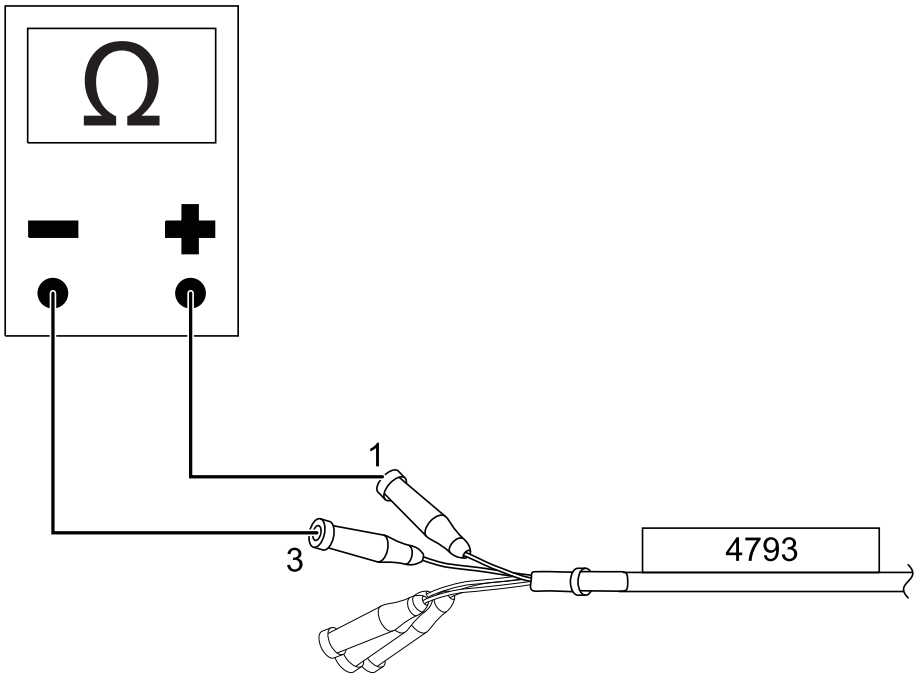
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3 C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3661 FMI 4.

Pin-Point Tests (SPN 3661 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

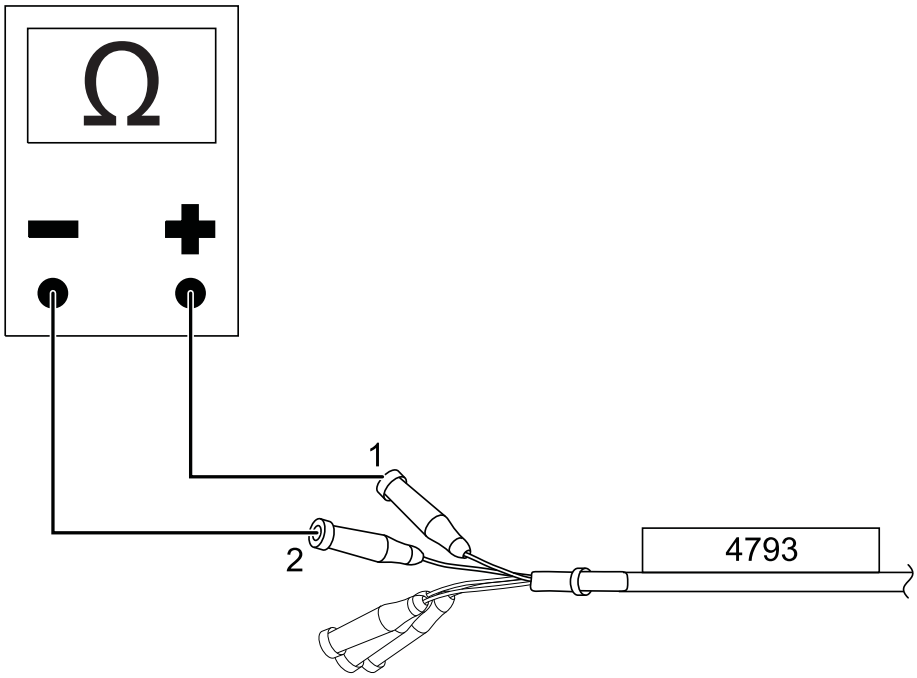


0000326241

Figure 671 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 3 Close and fuel injector 3 Open circuit. After repairs are complete, retest for SPN 3661 FMI 4.

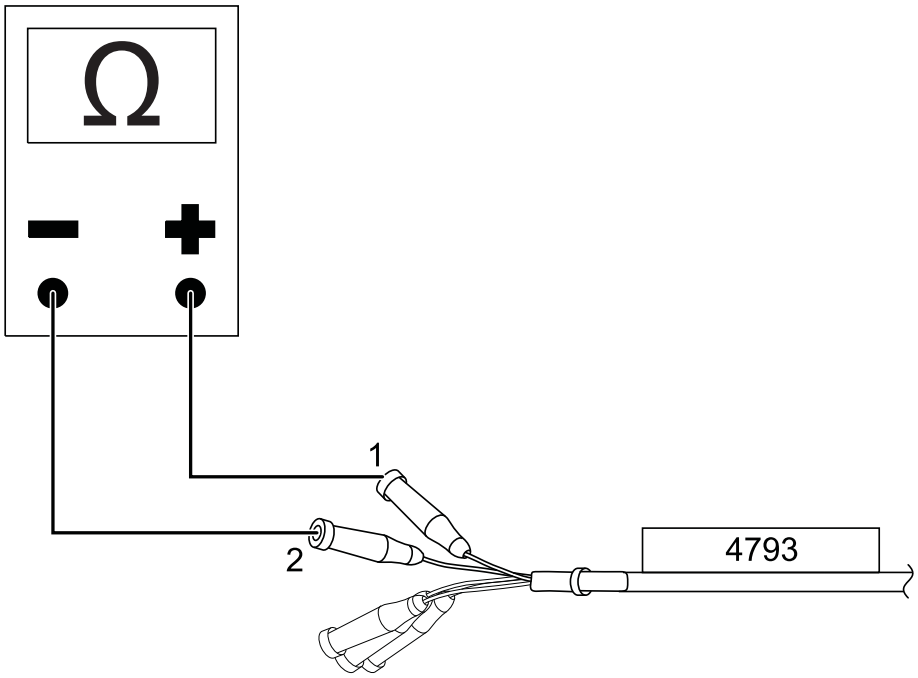


0000326341

Figure 672 Test 2 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326341

Figure 673 Test 3 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 3 Close circuit. After repairs are complete, retest for SPN 3661 FMI 4.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 3661 FMI 4.

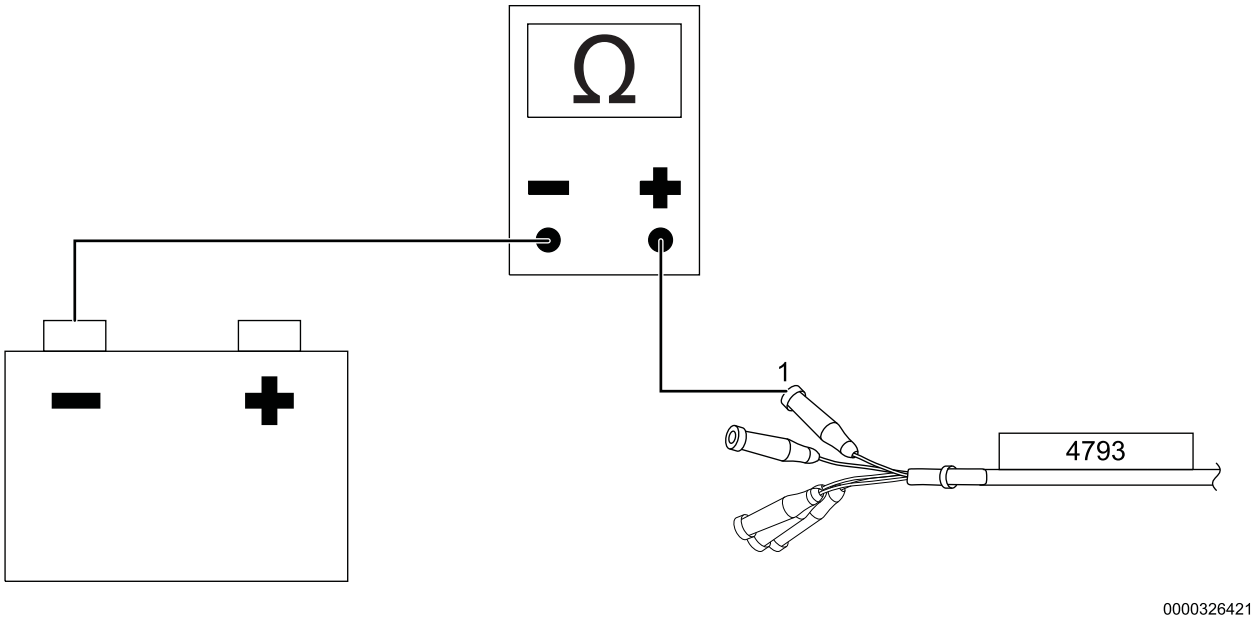


Figure 674 Test 4 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 3 Close H circuit. After repairs are complete, retest for SPN 3661 FMI 4.

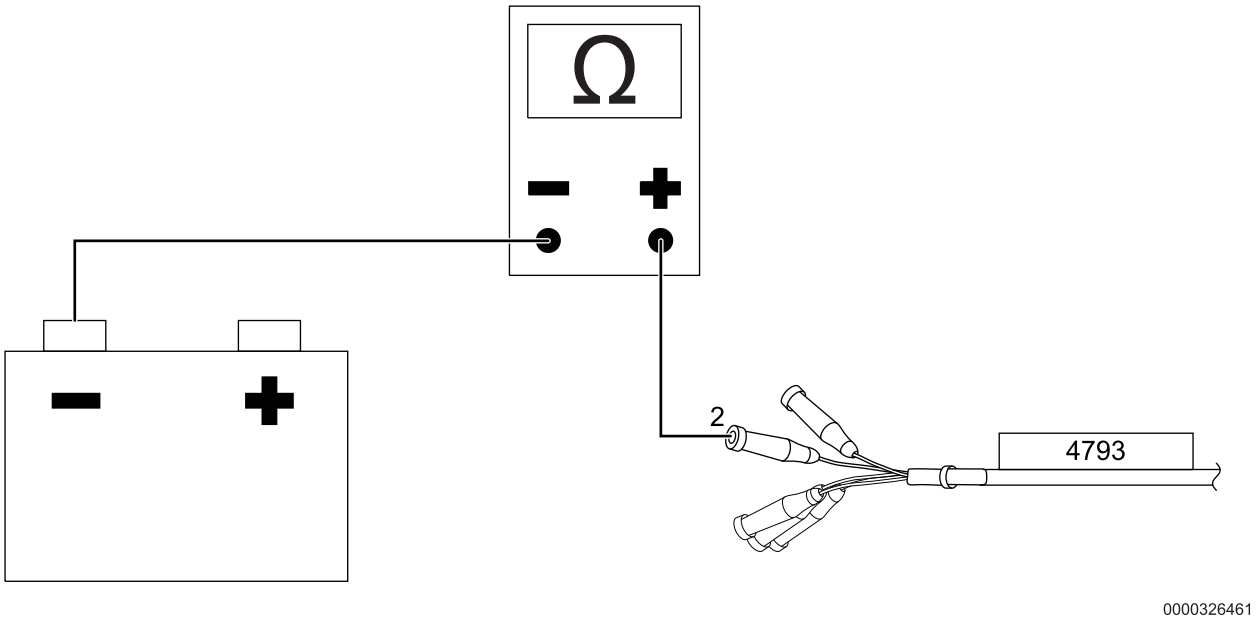


Figure 675 Test 5 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 3 Close L circuit. After repairs are complete, retest for SPN 3661 FMI 4.

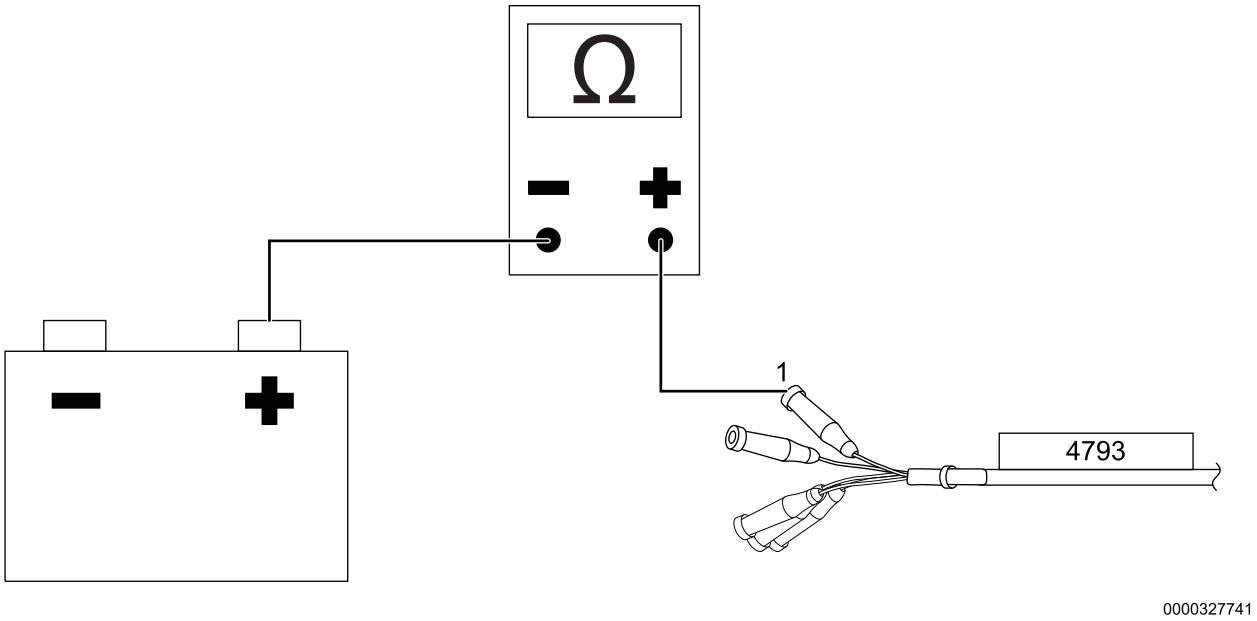


Figure 676 Test 6 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 3. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 3 Close L circuit. After repairs are complete, retest for SPN 3661 FMI 4.
	No: Repair short to PWR in fuel injector 3 Close H circuit. After repairs are complete, retest for SPN 3661 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3661 FMI 4 fault code diagnostics.

SPN 3662 FMI 4 - Injector 4 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 4 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3662 FMI 4. Is EST DTC list SPN 3662 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

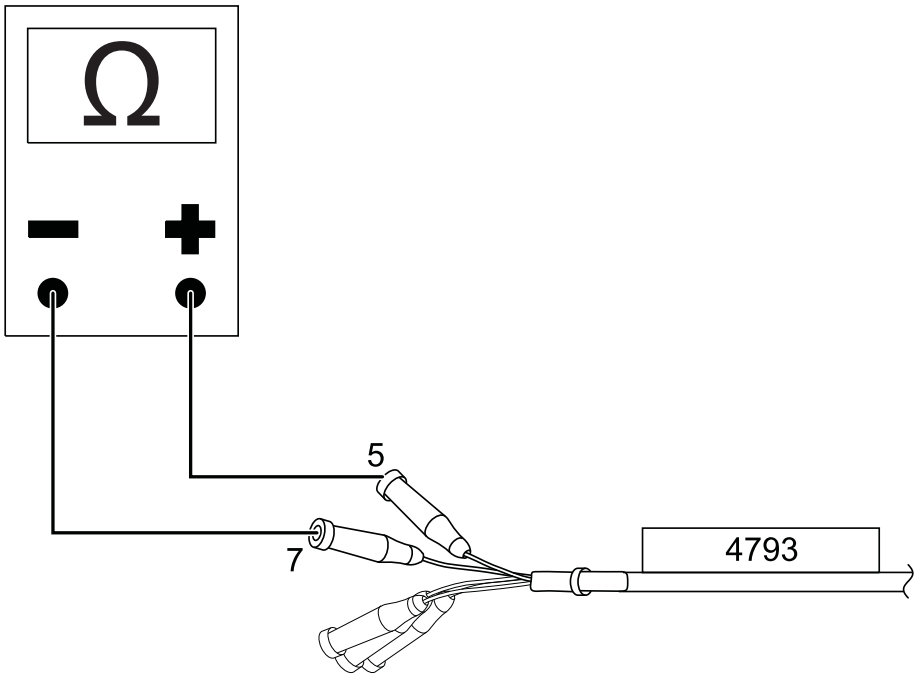
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
A. Key OFF B. Disconnect UVC 3 C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?		Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3662 FMI 4.

Pin-Point Tests (SPN 3662 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

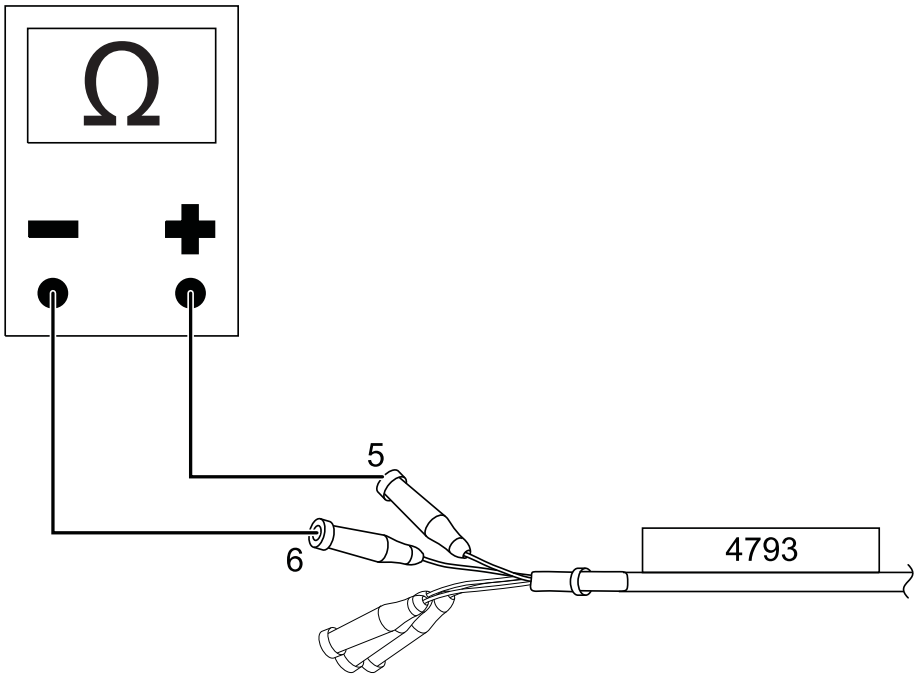


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Figure 677 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 4 Close and fuel injector 4 Open circuit. After repairs are complete, retest for SPN 3662 FMI 4.

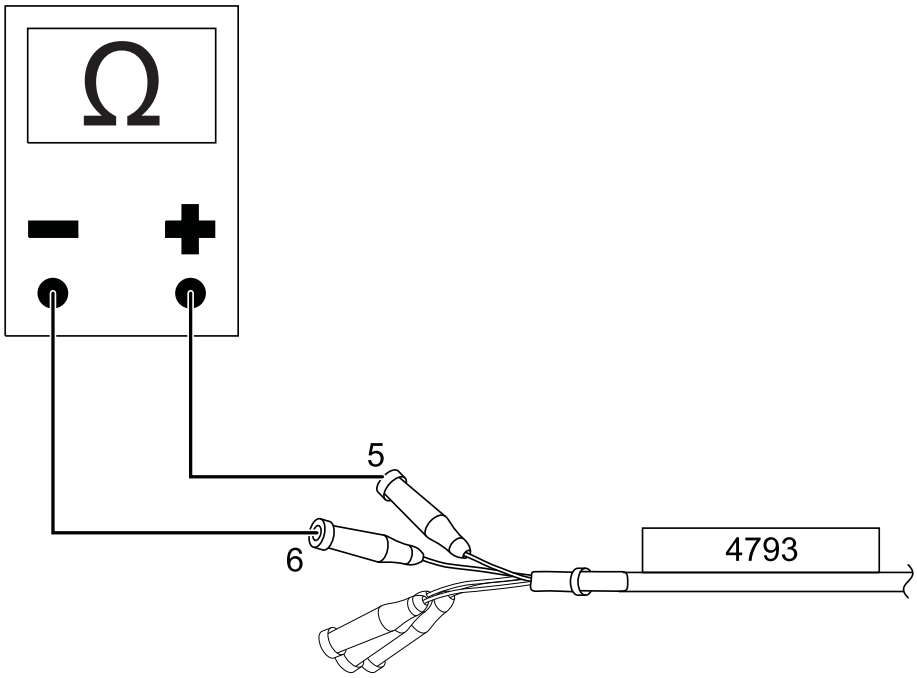


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Figure 678 Test 2 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326381

Figure 679 Test 3 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 3 Close circuit. After repairs are complete, retest for SPN 3662 FMI 4.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 3662 FMI 4.

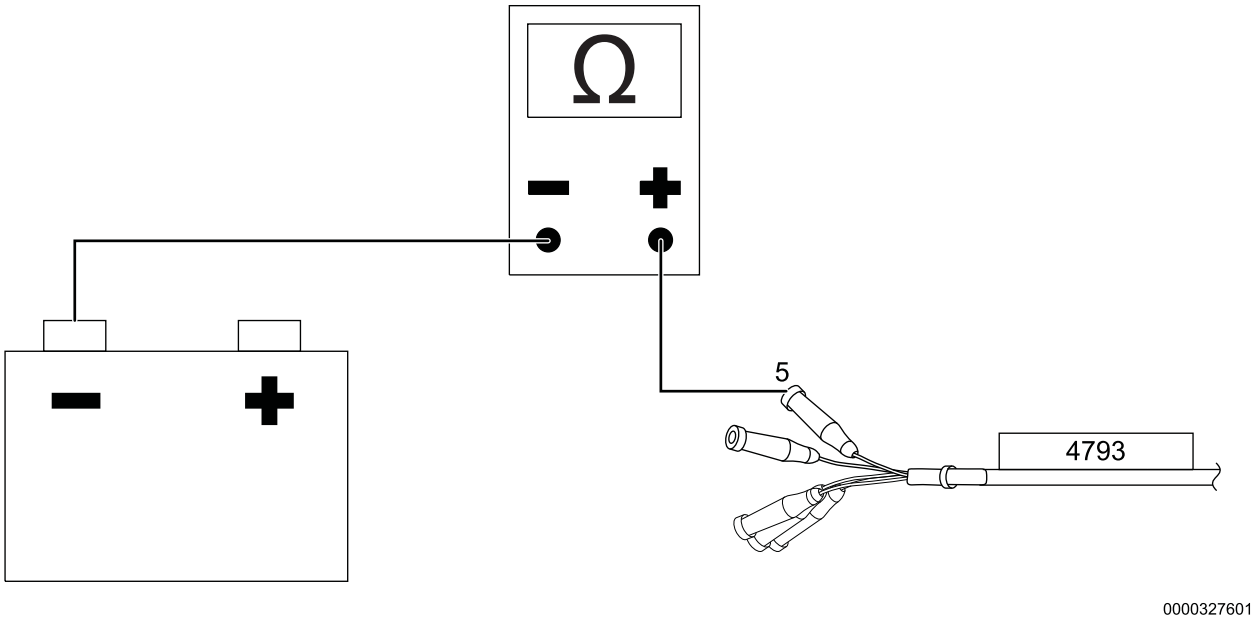


Figure 680 Test 4 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 4 Close H circuit. After repairs are complete, retest for SPN 3662 FMI 4.

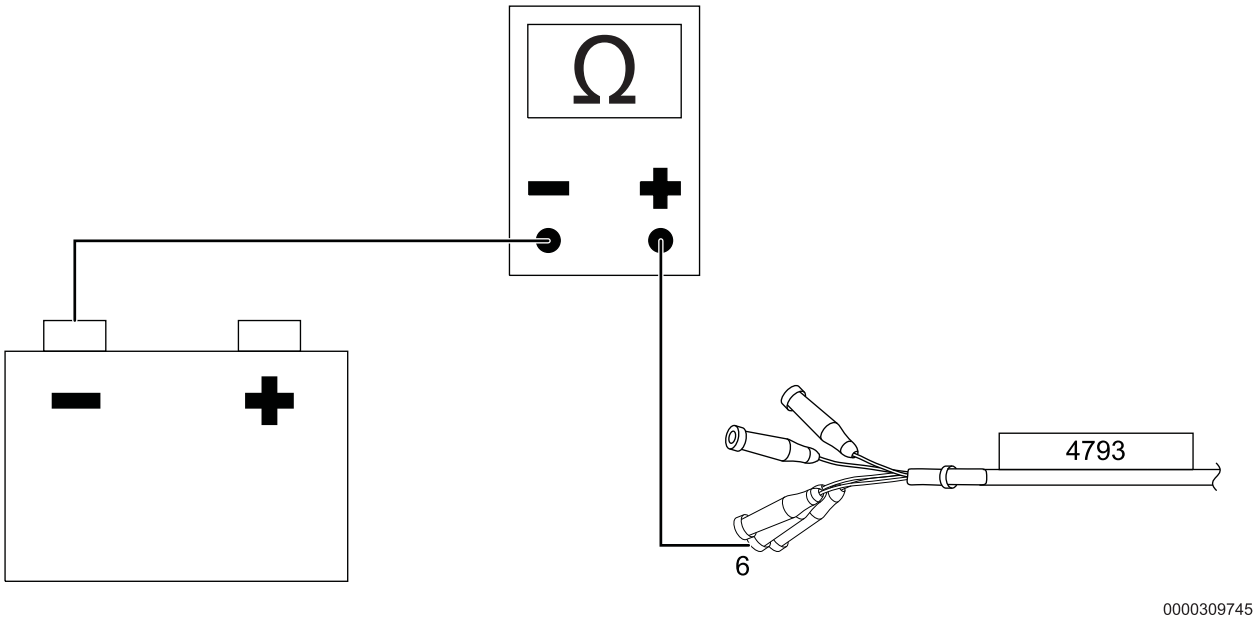


Figure 681 Test 5 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 4 Close L circuit. After repairs are complete, retest for SPN 3662 FMI 4.

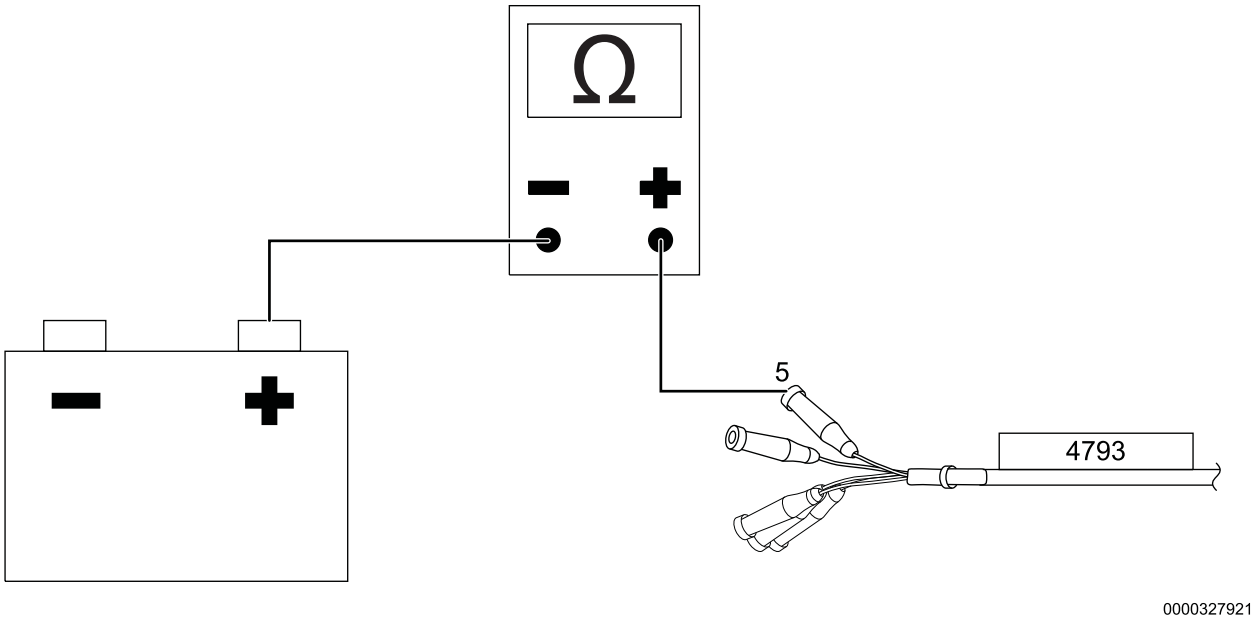


Figure 682 Test 6 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 4. C. Disconnect Under Valve Connector (UVC) connector 3. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 4 Close L circuit. After repairs are complete, retest for SPN 3662 FMI 4.
	No: Repair short to PWR in fuel injector 2 Close H circuit. After repairs are complete, retest for SPN 3660 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3660 FMI 4 fault code diagnostics.

SPN 3663 FMI 4 - Injector 5 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 5 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3663 FMI 4. Is EST DTC list SPN 3663 FMI 4 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

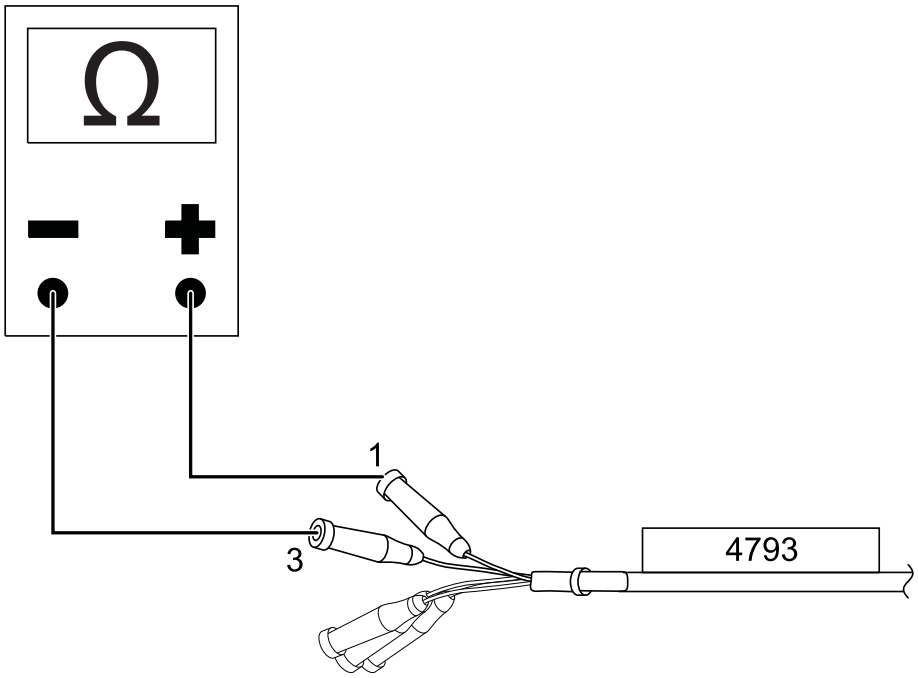
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
	A. Key OFF B. Disconnect UVC 4 C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3663 FMI 4.

Pin-Point Tests (SPN 3663 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

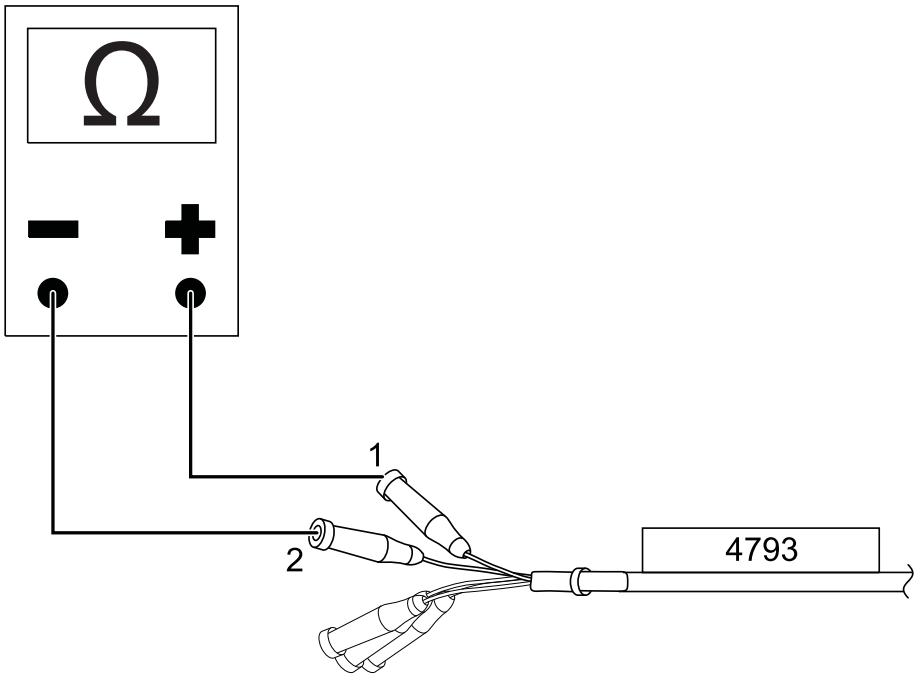


0000326241

Figure 683 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-3.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 5 Close and fuel injector 5 Open circuit. After repairs are complete, retest for SPN 3663 FMI 4.

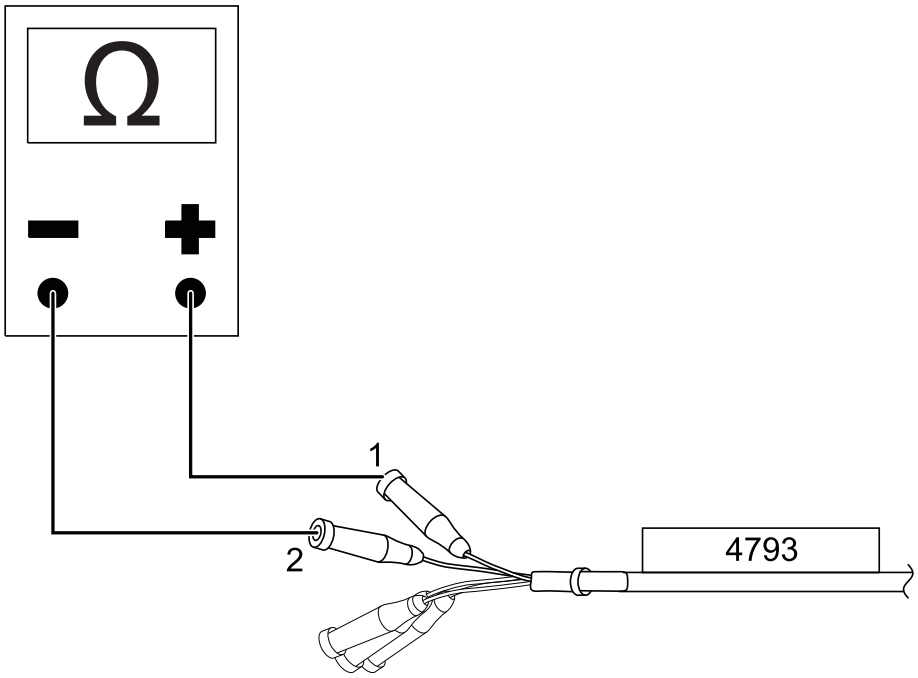


0000326341

Figure 684 Test 2 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326341

Figure 685 Test 3 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 5 Close circuit. After repairs are complete, retest for SPN 3663 FMI 4.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 3663 FMI 4.

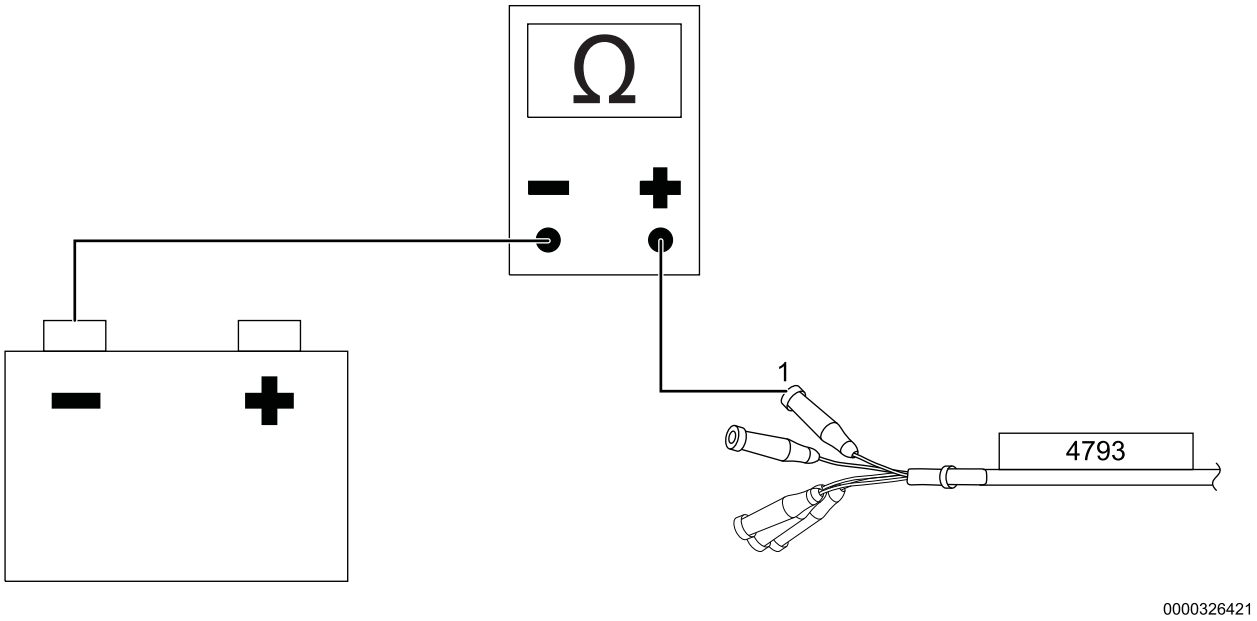


Figure 686 Test 4 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 5 Close H circuit. After repairs are complete, retest for SPN 3663 FMI 4.

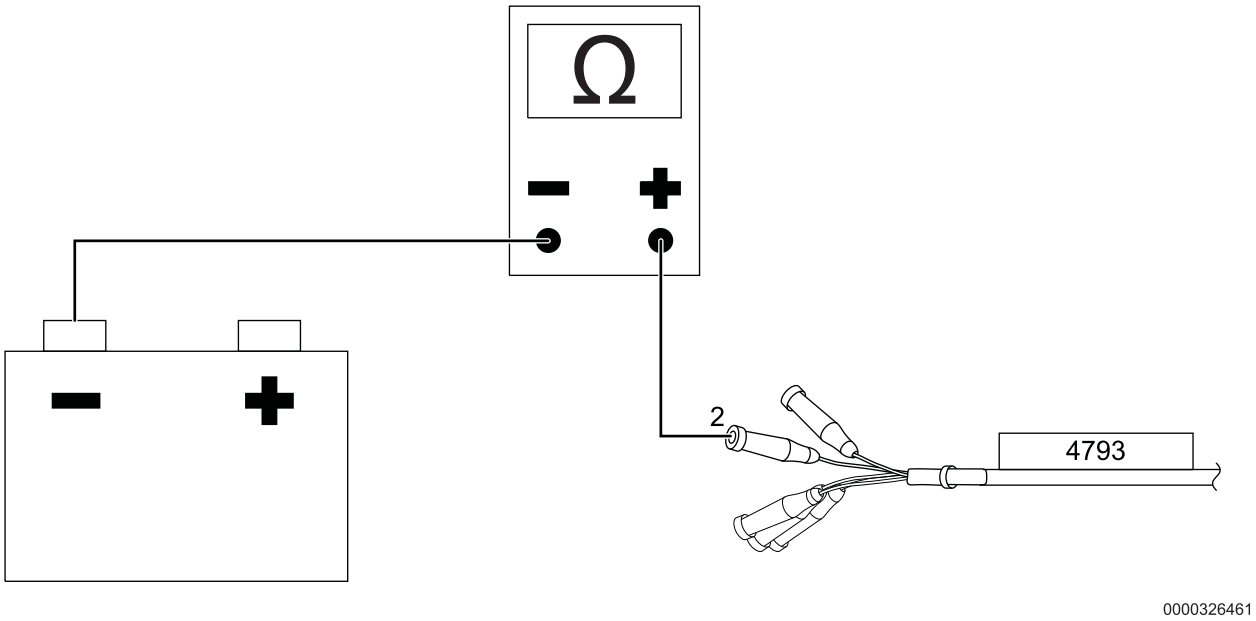


Figure 687 Test 5 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 5 Close L circuit. After repairs are complete, retest for SPN 3663 FMI 4.

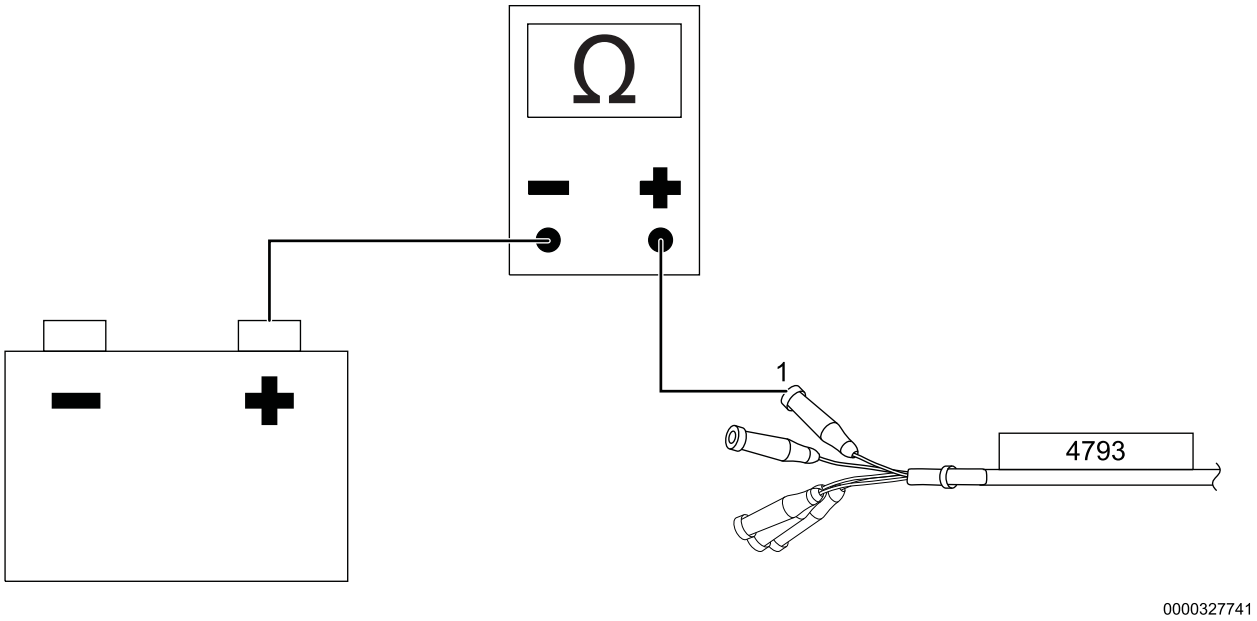


Figure 688 Test 6 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 5. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 5 Close L circuit. After repairs are complete, retest for SPN 3663 FMI 4.
	No: Repair short to PWR in fuel injector 5 Close H circuit. After repairs are complete, retest for SPN 3663 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3663 FMI 4 fault code diagnostics.

SPN 3664 FMI 4 - Injector 6 close coil – short circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Short circuit detection on injector Close Coil	[Current on injector driver circuit > 50 Amps for 40 e-6 seconds AND Current Rise time for close coil] ≥ 0.0000024 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts SPN/FMI 2797/6 and 2798/6 are NOT Active

Fault Overview

Fault is set when short circuit is detected on injector 6 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Close H shorted to Close L
- Close H short to GND
- Close L short to GND
- Close H short to PWR
- Close L short to PWR
- Failed Injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3664 FMI 4. Is EST DTC list SPN 3664 FMI 4 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

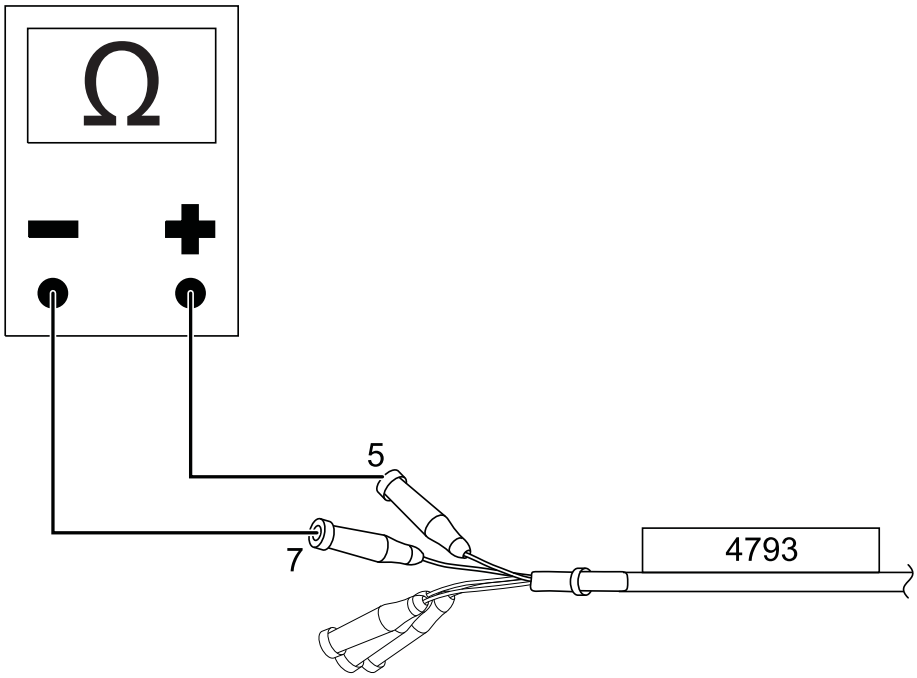
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
	A. Key OFF B. Disconnect UVC 4 C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3664 FMI 4.

Pin-Point Tests (SPN 3664 FMI 4)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)

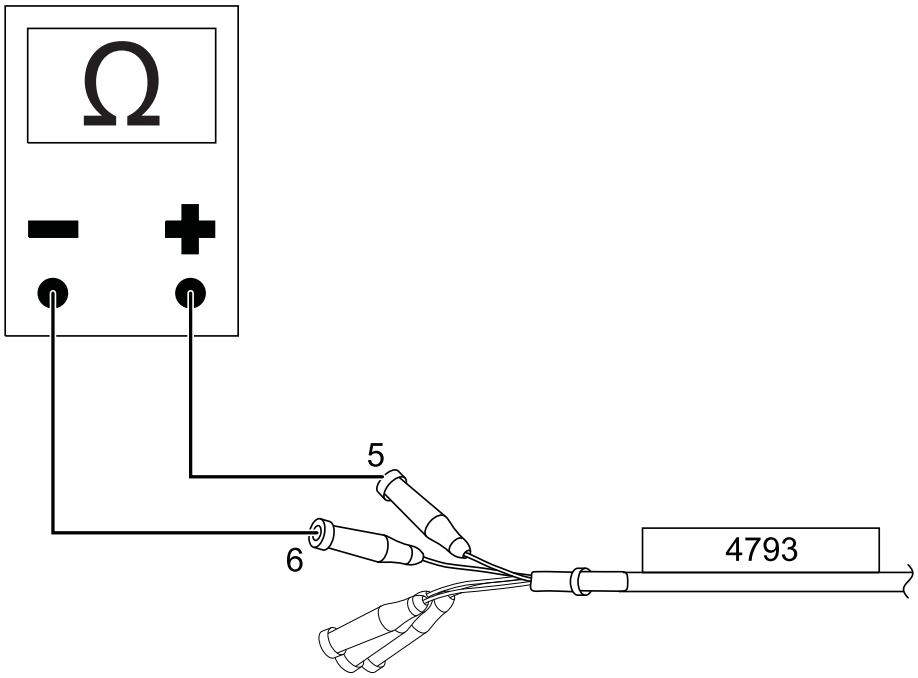


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Figure 689 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-7.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 2.
	No: Repair short between fuel injector 6 Close and fuel injector 6 Open circuit. After repairs are complete, retest for SPN 3664 FMI 4.

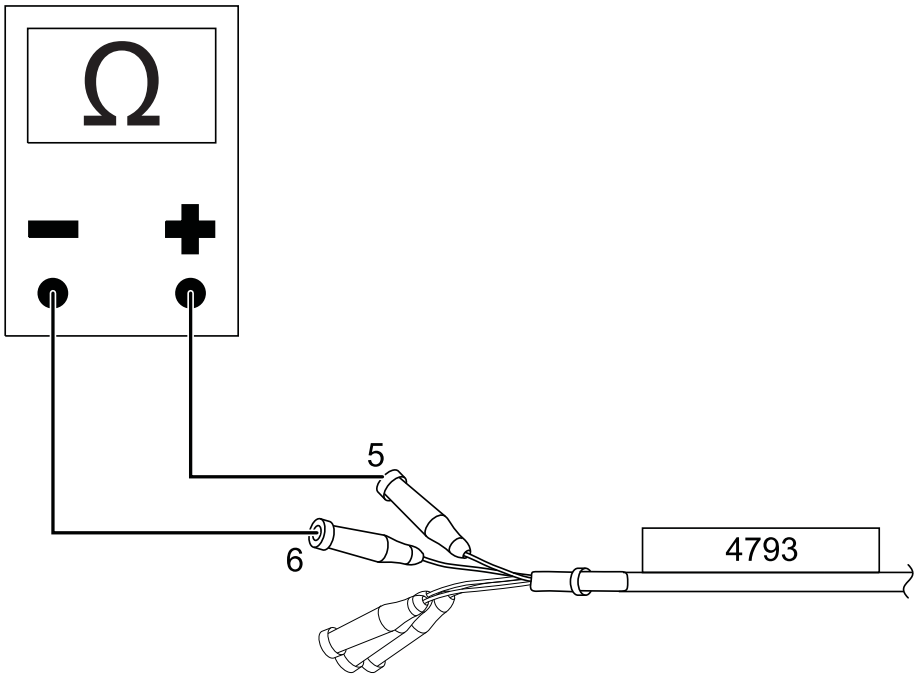


0000326381

Figure 690 Test 2 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 2 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 2	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Go to Test 3.
	No: Go to Test 4.



0000326381

Figure 691 Test 3 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 3 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair short in fuel injector 6 Close circuit. After repairs are complete, retest for SPN 3664 FMI 4.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 3664 FMI 4.

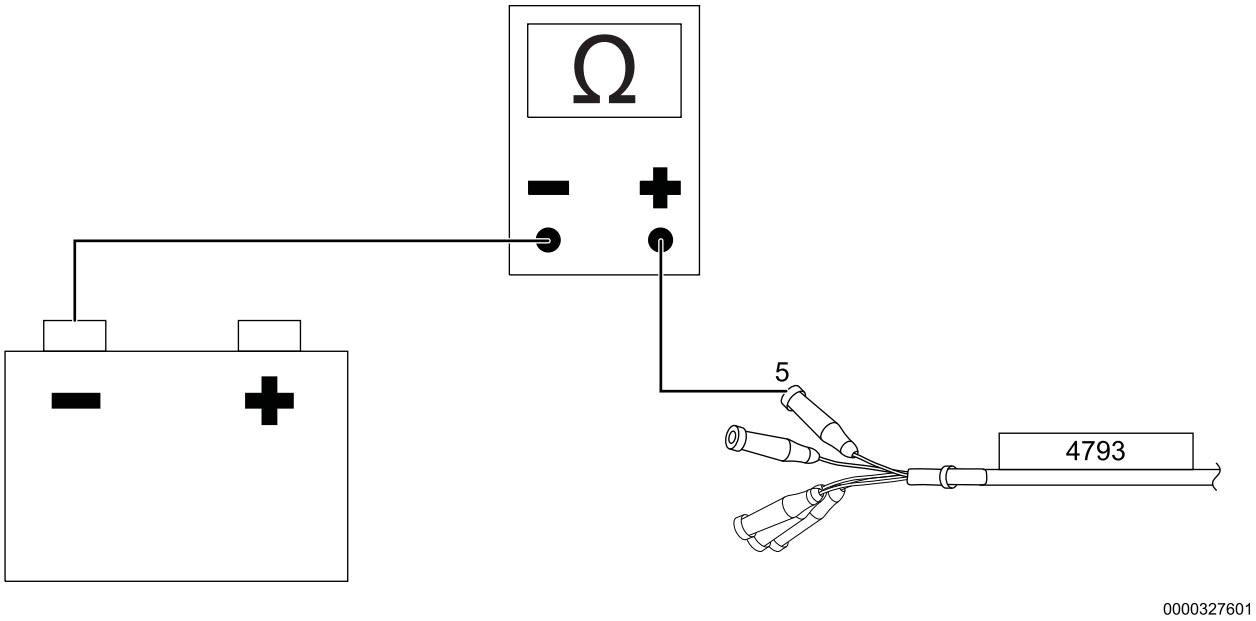


Figure 692 Test 4 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 4 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 5.
	No: Repair short to GND in fuel injector 6 Close H circuit. After repairs are complete, retest for SPN 3664 FMI 4.

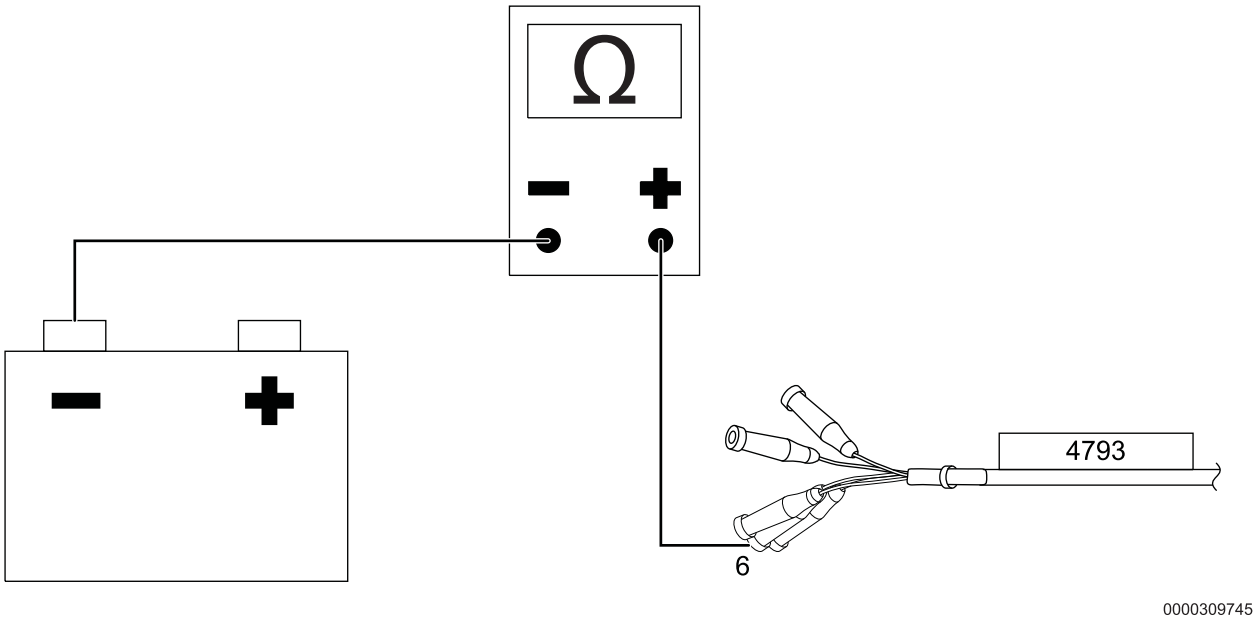


Figure 693 Test 5 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 5 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 5	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-6 and known good GND.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Go to Test 6.
	No: Repair short to GND in fuel injector 6 Close L circuit. After repairs are complete, retest for SPN 3664 FMI 4.

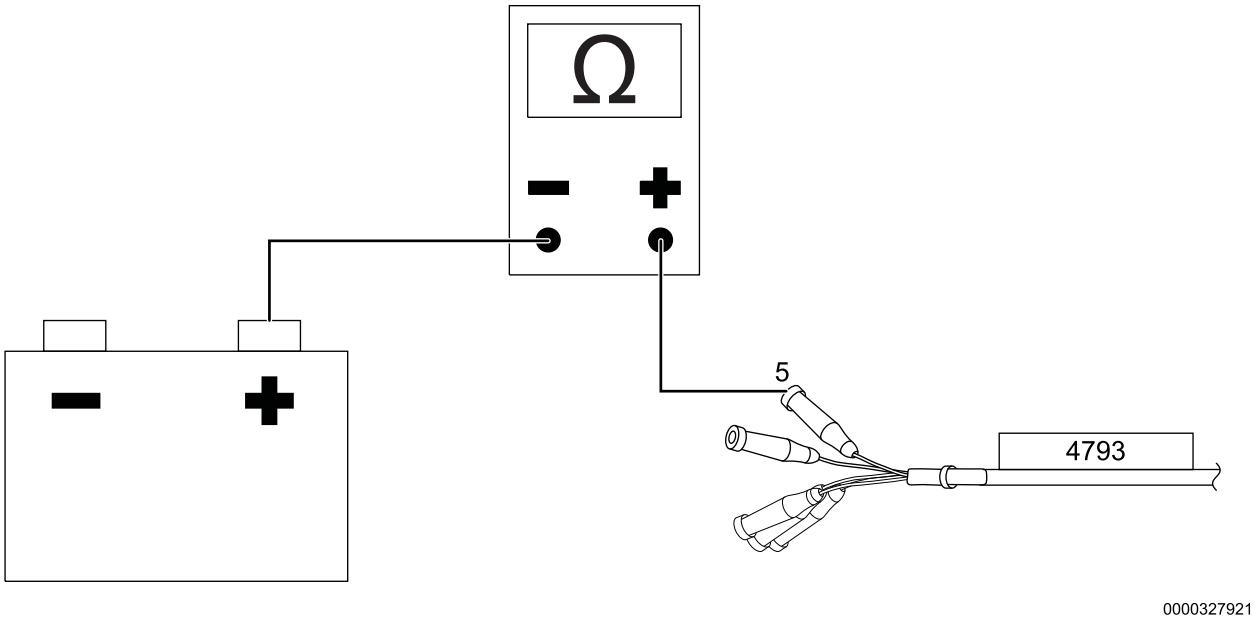


Figure 694 Test 6 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 6 Setup
A. Key OFF. B. Disconnect fuel injector 6. C. Disconnect Under Valve Connector (UVC) connector 4. D. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. E. Key ON.

Test 6	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and PWR.	Greater than 1000 ohms
Decision	
Is resistance greater than 1000 ohms?	Yes: Repair short to PWR in fuel injector 6 Close L circuit. After repairs are complete, retest for SPN 3664 FMI 4.
	No: Repair short to PWR in fuel injector 6 Close H circuit. After repairs are complete, retest for SPN 3664 FMI 4.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3664 FMI 4 fault code diagnostics.

SPN 3659 FMI 5 - Injector 1 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 1 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3659 FMI 5. Is EST DTC list SPN 3659 FMI 5 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

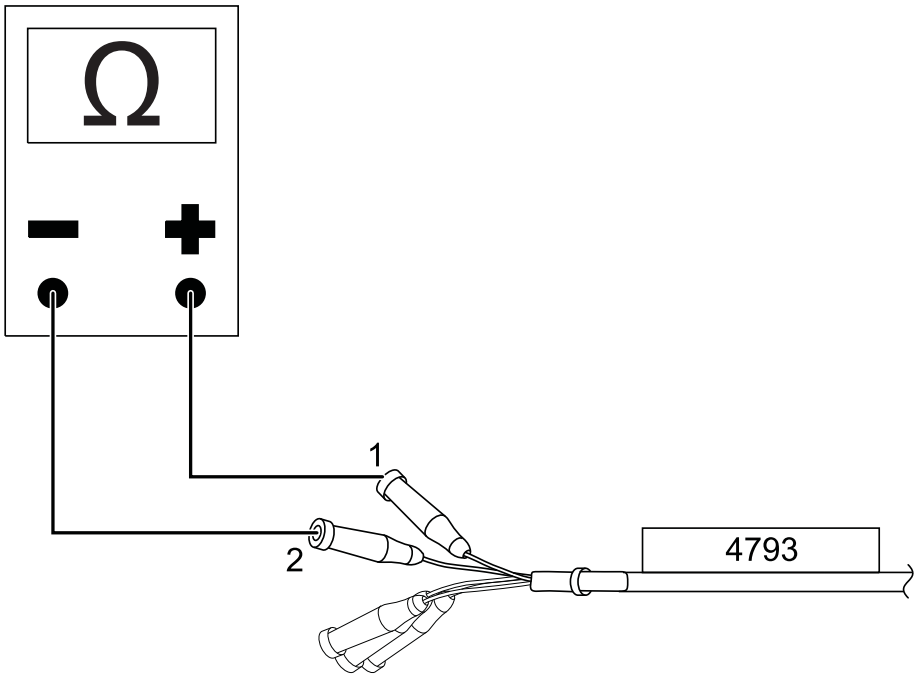
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
	A. Key OFF B. Disconnect UVC 2. C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3659 FMI 5.

Pin-Point Tests (SPN 3659 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



0000326341

Figure 695 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3659 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 1. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 3659 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 1. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 1 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 1. After repairs are complete, retest for SPN 3659 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 1. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 1 pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3659 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3659 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3659 FMI 5 fault code diagnostics.

SPN 3660 FMI 5 - Injector 2 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 2 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3660 FMI 5. Is EST DTC list SPN 3660 FMI 5 active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

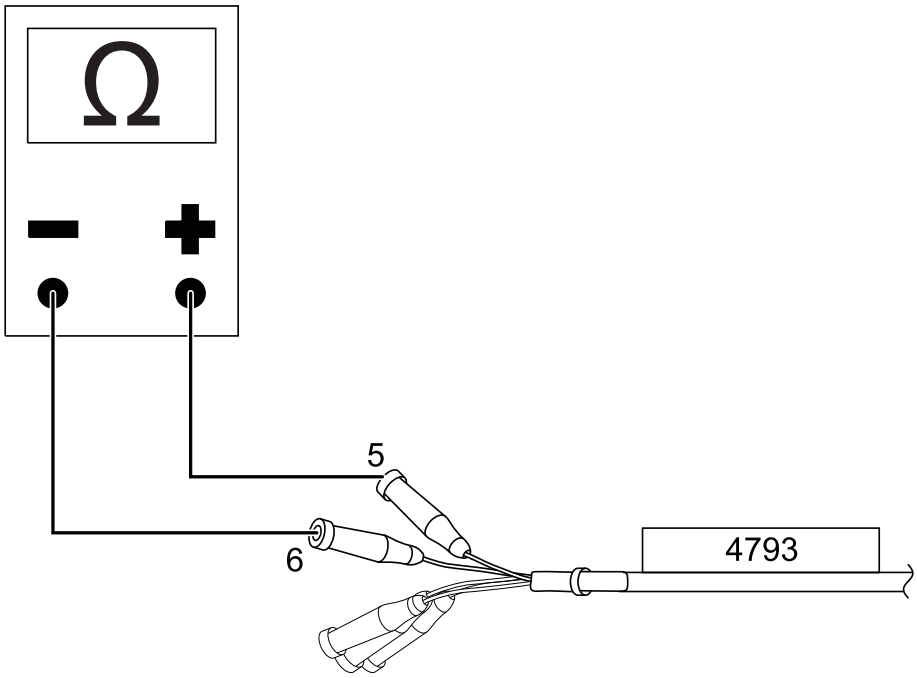
Step 2	Inspect connections at Under Valve Connector (UVC) connector 2.	Decision
	A. Key OFF. B. Disconnect UVC 2. C. Check UVC 2 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 2 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3660 FMI 5.

Pin-Point Tests (SPN 3660 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 696 Test 1 Under Valve Connector (UVC) connector 2 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 2. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3660 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 2. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 3660 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 2. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 2 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 2. After repairs are complete, retest for SPN 3660 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 2. D. Disconnect Under Valve Connector (UVC) connector 2. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 2 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 2 pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3660 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3660 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3660 FMI 5 fault code diagnostics.

SPN 3661 FMI 5 - Injector 3 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 3 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3661 FMI 5. Is EST DTC list SPN 3661 FMI 5 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

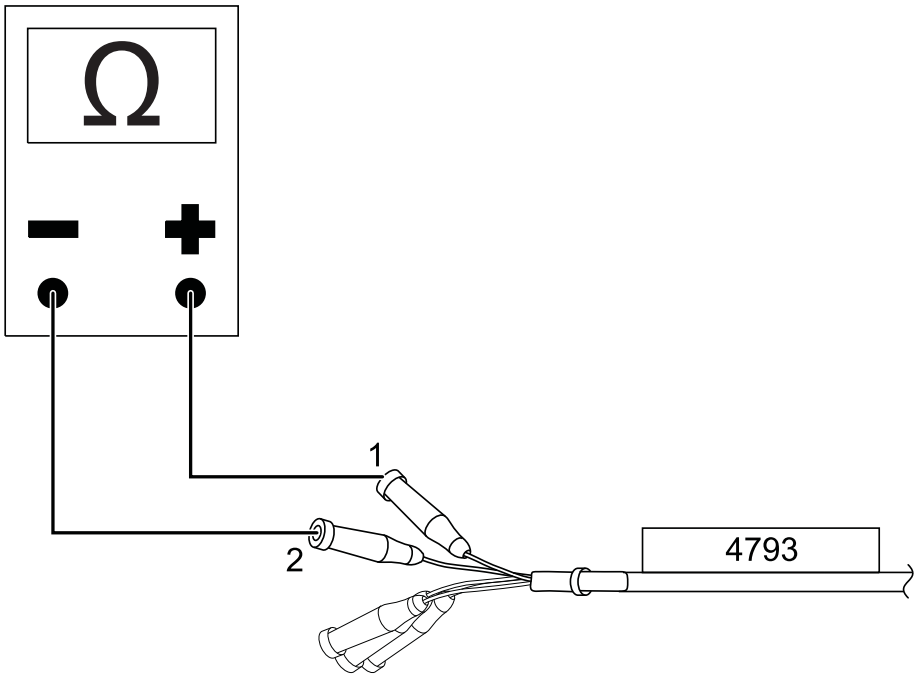
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
	A. Key OFF B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3661 FMI 5.

Pin-Point Tests (SPN 3661 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 697 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3661 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 3. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 3661 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 3. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 3 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 3. After repairs are complete, retest for SPN 3661 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 3. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 3 pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3661 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3661 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3661 FMI 5 fault code diagnostics.

SPN 3662 FMI 5 - Injector 4 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 4 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3662 FMI 5. Is EST DTC list SPN 3662 FMI 5 active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

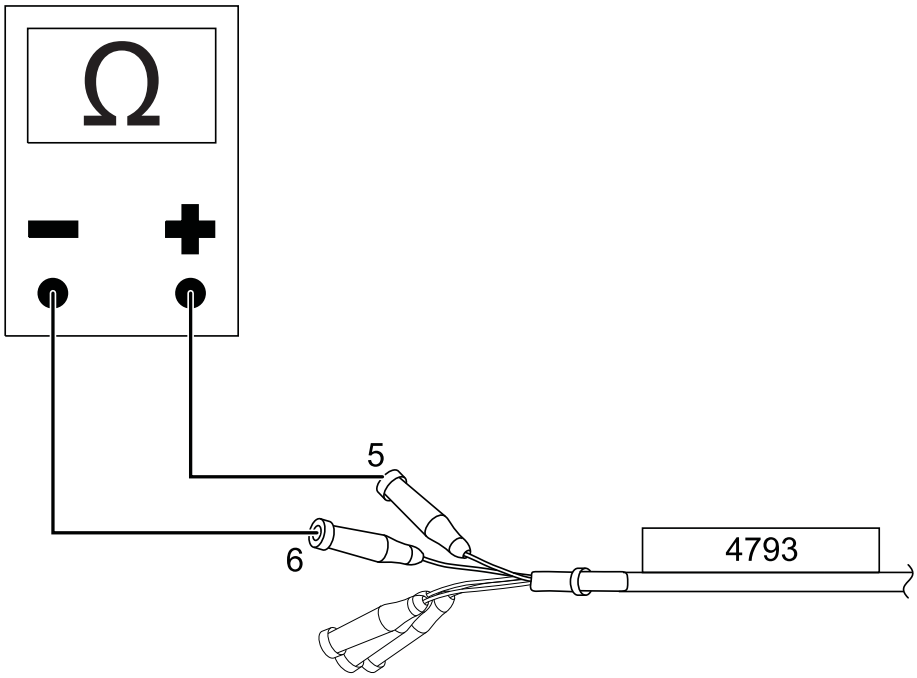
Step 2	Inspect connections at Under Valve Connector (UVC) connector 3.	Decision
	A. Key OFF. B. Disconnect UVC 3. C. Check UVC 3 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 3 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3662 FMI 5.

Pin-Point Tests (SPN 3662 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 698 Test 1 Under Valve Connector (UVC) connector 3 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 3. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3662 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 4. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 3662 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 4. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 4 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 4. After repairs are complete, retest for SPN 3662 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 4. D. Disconnect Under Valve Connector (UVC) connector 3. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 3 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 4 pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3662 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3662 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3662 FMI 5 fault code diagnostics.

SPN 3663 FMI 5 - Injector 5 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 5 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3663 FMI 5. Is EST DTC list SPN 3663 FMI 5 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

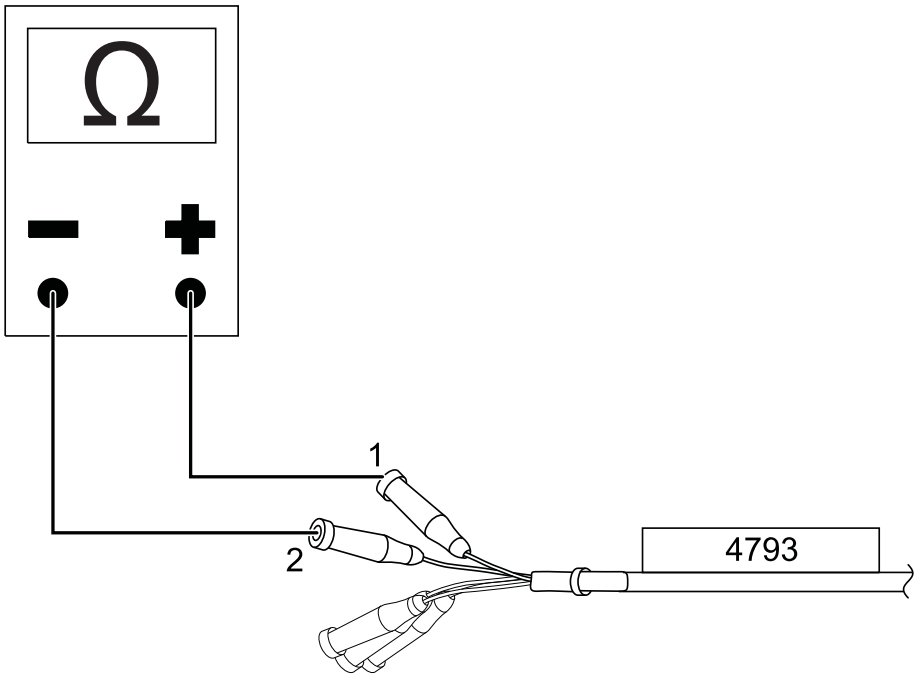
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
	A. Key OFF B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3663 FMI 5.

Pin-Point Tests (SPN 3663 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 699 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and pin-2.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3663 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 5. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 3663 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 5. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 5 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 5. After repairs are complete, retest for SPN 3663 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 5. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 5 pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3663 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3663 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3663 FMI 5 fault code diagnostics.

SPN 3664 FMI 5 - Injector 6 close coil – open circuit

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Open circuit detection on injector Close Coil	[Current on injector driver circuit < 25 Amps for 0.00035 seconds AND Current Rise time for Close coil] ≥ 0.0001 seconds AND ≤ 0.0008 seconds	Key ON Battery voltage > 9 Volts Energizing time for close coil > 0.0008 seconds Adaptive waveform is OFF {Defined in Operations summary Document} SPN FMI 2797/6 and 2798/6 are NOT active

Fault Overview

Fault is set when Open circuit is detected on injector 6 Close coil.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Final number of SPN identifies affected injector, and name in ServiceMaxx™ identifies cylinder in which injector is installed.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open in Open H circuit
- Open in Open L circuit
- Failed fuel injector

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3664 FMI 5. Is EST DTC list SPN 3664 FMI 5 active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

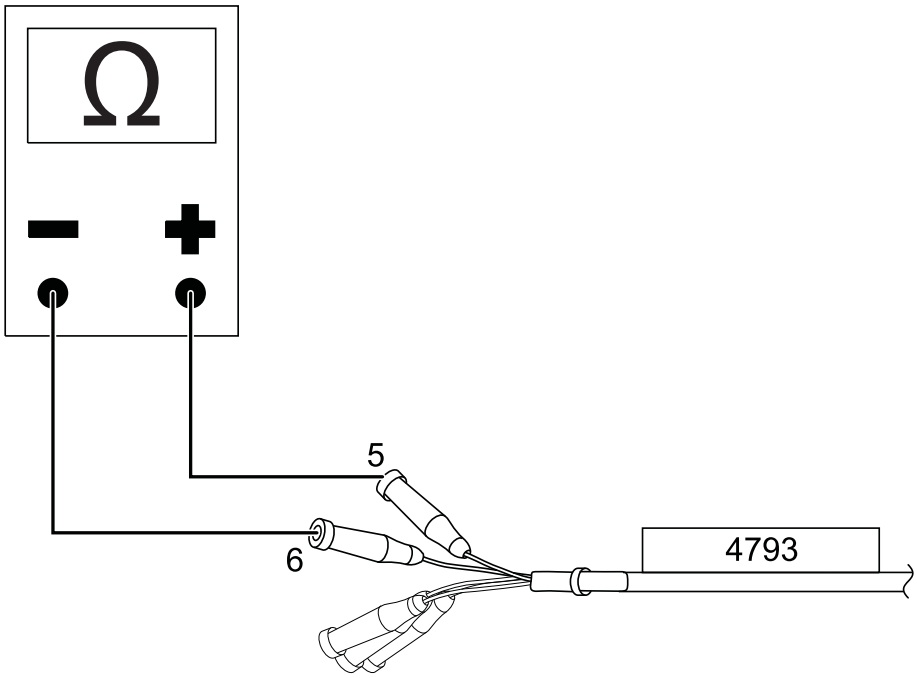
Step 2	Inspect connections at Under Valve Connector (UVC) connector 4.	Decision
	A. Key OFF. B. Disconnect UVC 4. C. Check UVC 4 and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are UVC 4 connector, harness, and terminals clean and undamaged?	Yes: Perform pinpoint tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3664 FMI 5.

Pin-Point Tests (SPN 3664 FMI 5)

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4793
- Digital Multimeter (DMM)



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Figure 700 Test 1 Under Valve Connector (UVC) connector 4 Circuit Resistance Check

Test 1 Setup
A. Key OFF. B. Disconnect Under Valve Connector (UVC) connector 4. C. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-5 and pin-6.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and Engine Control Module (ECM). After repairs are complete, retest for SPN 3664 FMI 5.
	No: Go to Test 2.

Test 2 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 6. D. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1 and pin 4.

Test 2	Specification
Using DMM measure resistance between fuel injector pin-1 and pin-4.	1 ± 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 3.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 3664 FMI 5.

Test 3 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 6. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 1.

Test 3	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-1 and fuel injector 6 pin-1.	< 0.5 ohms
Decision	
Is resistance less than 1.5 ohms?	Yes: Go to Test 4.
	No: Replace fuel injector 6. After repairs are complete, retest for SPN 3664 FMI 5.

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect fuel injector 6. D. Disconnect Under Valve Connector (UVC) connector 4. E. Connect Breakout Harness ZTSE4793 to vehicle harness and leave UVC connector 4 disconnected. F. Connect correct terminals from Terminal Test Kit ZTSE4435C to fuel injector pin 4.

Test 4	Specification
Using DMM measure resistance between Breakout Harness ZTSE4793 pin-2 and fuel injector 6pin-4.	< 0.5 ohms
Decision	
Is resistance less than 0.5 ohms?	Yes: Repair Open in Close H or Close L circuit between UVC harness and ECM. After repairs are complete, retest for SPN 3664 FMI 5.
	No: Repair Open in UVC harness Close H circuit. After repairs are complete, retest for SPN 3664 FMI 5.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3664 FMI 5 fault code diagnostics.

SPN 4257 FMI 7 - Injector Coking Compensation Factor Reached Maximum Authority

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Injector coking compensation factor maximum authority reached	Cumulative coking compensation value estimated by Injector Coking Compensation Factor accumulator model > 16%	Key ON Monitor enabling based on speed load table [Table A095]

Fault Overview

Fault code sets when Engine Control Module (ECM) determines injector coking compensation has reached its maximum level. Cumulative coking compensation value estimated by injector coking compensation factor accumulator model greater than 16%.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

Coking is buildup of deposits on the tip of the fuel injector.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Aged fuel injectors

Step 1		Decision
	Remove fuel injectors. Inspect injectors for coking on tip of fuel injectors. Are fuel injector tips coked?	Yes: Replace all fuel injectors. Reset programmable parameter for coking compensation. After repairs are complete, retest for SPN 4257 FMI 7.
		No: Retest for SPN 4257 FMI 7.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4257 FMI 7 fault code diagnostics.

SPN 4257 FMI 16 - Multiple Injector High Flow fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel Injection Quantity / Timing HIGH on ALL injectors	Measured exhaust gas temperature Value MINUS modeled exhaust gas temperature value > 162°F (72°C)	1. Engine Speed ≥ 1600 rpm 2. Engine Torque command ≥ 765 Nm 3. Absolute value of Engine speed gradient < 8.008 rpm/s 4. Absolute value of Engine torque command < 15 Nm/s 5. Aftertreatment DPF differential pressure based on table 500 hPa 6. Engine turbocharger 1 turbine outlet pressure < 500 hPa 7. Engine exhaust gas pressure MINUS IMP is 1400 -2300 hPa 8. Estimated DPF soot load < 3.75 g/s 9. Engine Exhaust gas temperature > 437°F (225°C) Conditions 1 through 9 (listed above) are satisfied ≥ 6 seconds ECT > 104°F (40°C) EGR Valve Position > 38% DPF regeneration Not Active Barometric pressure ≥ 73.5 kPa AND and ≤ 103 kPa Ambient temperature ≥ -45°F (7°C) and ≤ 140°F (60°C) PTO Not active > 5 seconds Exhaust Brake or Vehicle Retarder Not active > 5 seconds Torque limiting in Limp Home Mode Not active Fuel cut off in deceleration Not active Engine Smoke limitation Not active Battery Voltage ≥ 9 volts and ≤ 16 volts Key- On Engine-Running (KOER) ≥ 30 seconds SCR Warmup Not active. Inactive: SPN 27 FMI 14 (EGR); SPN 51 FMI 3, 4, 7 (ETP); SPN 94 FMI 3 and 4

		(FDP); SPN 102 FMI 3, 4, 7, 16, and 18 (IMP); SPN 105 FMI 2, 3, 4 (IMT); SPN 108 FMI 3 and 4 (BARO); SPN 110 FMI 2, 3, and 4 (ECT); SPN 132 FMI 3 and 4 (MAF); SPN 164 FMI 0, 3, 4, 16, and 18 (ICP); SPN 175 FMI 2, 3, and 4 (EOT); SPN 636 FMI 2 and 7; SPN 651 FMI 4 and 5 (INJ); SPN 652 FMI 4 and 5 (INJ); SPN 653 FMI 4 and 5 (INJ); SPN 654 FMI 4 and 5 (INJ); SPN 655 FMI 4 and 5 (INJ); SPN 656 FMI 4 and 5 (INJ); SPN 679 FMI 3 and 4 (IPR); SPN 1173 FMI 16 (TC2CIT); SPN 1189 FMI 3 and 4 (TC2WC); SPN 1322 FMI 31(Engine); SPN 1323 FMI 31 (Engine); SPN 1324 FMI 31 (Engine); SPN 2659 FMI 20 and 21 (AMS); SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR); SPN 3055 FMI 2 (INJ); SPN 3242 FMI 3 and 4 (DPFIT); SPN 3246 FMI 3 and 4 (DPFOT); SPN 3464 FMI 31 (ETP); SPN 3471 FMI 1 and 7 (AFTPC); SPN 3479 FMI 3, 5, and 6 (AFTPC); SPN 3480 FMI 3 and 4 (AFTFIS); SPN 3482 FMI 3 and 4 (AFTFSV); SPN 3556 FMI 1 and 7 (AFTFP2); SPN 3936 FMI 2, 8, and 20 (DPF); SPN 4257 FMI 7 (INJ); SPN 4765 FMI 3 and 4 (DOCIT) ; SPN 4766 FMI 10 (DOCOT); SPN 5543 FMI 3, 4, and 5 (EBPV)

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Exhaust Gas Temperature (EGT) temperature is higher than expected more than 162°F (72°C)

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

• SPN 27 FMI 14 (EGR)	• SPN 51 FMI 3, 4, 7 (ETP)	• SPN 94 FMI 3 and 4 (FDP)	• SPN 102 FMI 3, 4, 7, 16, and 18 (IMP)
• SPN 105 FMI 2, 3, 4 (IMT)	• SPN 108 FMI 3 and 4 (BARO)	• SPN 110 FMI 2, 3, and 4 (ECT)	• SPN 132 (MAF)
• SPN 164 FMI 0, 3, 4, 16, and 18 (ICP)	• SPN 172 (IAT)	• SPN 173 (EGT)	• SPN 175 FMI 2, 3, and 4 (EOT)
• SPN 188 FMI 0 and 1 (Engine)	• SPN 651 - 656 FMI 4 and 5 (INJ)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 1173 FMI 16 (TC2CIT)
• SPN 1189 FMI 3 and 4 (TC2WC)	• SPN 1322 - 1328 FMI 31 (Engine)	• SPN 2630 (CACOT)	• SPN 2659 FMI 20 and 21 (AMS)
• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)	• SPN 3055 FMI 2 (INJ)	• SPN 3464 FMI 31 (ETP)	• SPN 3471 FMI 1 and 7 (AFTPC)
• SPN 3479 (AFTPC)	• SPN 3480 FMI 3 and 4 (AFTFIS)	• SPN 3482 FMI 3 and 4 (AFTFSV)	• SPN 3556 FMI 1 and 7 (AFTFP2)
• SPN 3936 (DPF)	• SPN 4257 FMI 7 (INJ)	• SPN 5395 FMI 0 and 1 (Engine)	• SPN 5543 FMI 3, 4, and 5 (EBPV)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Restricted exhaust
- Restricted intake
- Mechanical cylinder inbalance
- Failed fuel injector

Step 1	Check for associated faults	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1760). Is EST DTC list free of Associated Faults?	Yes: Go to step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4257 FMI 16.

Step 2	Check for active or pending fault	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4257 FMI 16. Is EST DTC list SPN 4257 FMI 16 active or pending?	Yes: Go to step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect intake air system for leaks, restrictions, and damage.	Decision
	Perform Intake Air Inspection (page 2365). Is intake air system free of leaks, restrictions, and damage?	Yes: Go to step 4.
		No: Repair leaks, restrictions, and damage. After repairs are complete, retest for SPN 4257 FMI 16.

Step 4	Exhaust system inspection	Decision
	Inspect exhaust system for leaks and physical damage. Is exhaust system free of leaks and physical damage?	Yes: Go to step 5.
		No: Repair or replace leaking or damaged exhaust components. Refer to Fault Facts. After repairs are complete, retest for SPN 4257 FMI 16.

Step 5	Check Diesel Particulate Filter Differential Pressure	Decision
	KOER, using EST with ServiceMaxx™ software, check DPFDP. Is DPFDP less than 0.5 psi at high idle?	Yes: Go to step 6.
		No: Perform OBFCT.

Step 6	Mechanical Cylinder Imbalance	Decision
	Determine if the engine has a mechanical cylinder balance problem (compression loss). Perform Crankcase Pressure Test (page xxx). Does engine have excessive crankcase pressure?	Yes: Repair base engine compression imbalance. After repairs are complete, retest for SPN 4257 FMI 16.
		No: Go to step 7.

Step 7	Multiple Cylinder cutout test	Decision
	Determine if engine has a fuel injector problem. Perform Multiple Cylinder Cutout Test (page xxx). Did one or more cylinders have significant speed difference(s) than the others?	Yes: Go to step 8
		No: Retest for SPN 4257 FMI 16.

Step 8	Failed fuel injector	Decision
	Inspect for failed valve train components. Remove upper valve cover (see Engine Service Manual). Inspect for bent valves, fallen bridges, and valves out of adjustment. Is valve train free of failed valve train components?	Yes: Replace fuel injector suspected by Multiple Cylinder Cutout Test. After repairs are complete, retest for SPN 4257 FMI 16.
		No: Repair failed valve train components. After repairs are complete retest for SPN 4257 FMI 16.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4257 FMI 16 fault code diagnostics.

SPN 4257 FMI 18 - Multiple Injector Low Flow fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Fuel Injection Quantity / Timing LOW on ALL injectors	Modeled exhaust gas temperature minus exhaust gas temperature > -169°F (-76°C)	1. Engine Speed ≥ 1600 rpm 2. Engine Torque command ≥ 765 Nm 3. Absolute value of Engine speed gradient < 8.008 rpm/s 4. Absolute value of Engine torque command < 15 Nm/s 5. Aftertreatment DPF differential pressure based on table 500 hPa 6. Engine turbocharger 1 turbine outlet pressure < 500 hPa 7. Engine exhaust gas pressure MINUS IMP is 1400 -2300 hPa 8. Estimated DPF soot load < 3.75 g/s 9. Engine Exhaust gas temperature > 437°F (225°C) Conditions 1 through 9 (listed above) are satisfied ≥ 6 seconds ECT > 104°F (40°C) EGR Valve Position > 38% DPF regeneration Not Active Barometric pressure ≥ 73.5 kPa AND and ≤ 103 kPa Ambient temperature ≥ -45°F (7°C) and ≤ 140°F (60°C) PTO Not active > 5 seconds Exhaust Brake or Vehicle Retarder Not active > 5 seconds Torque limiting in Limp Home Mode Not active Fuel cut off in deceleration Not active Engine Smoke limitation Not active Battery Voltage ≥ 9 volts and ≤ 16 volts Key- On Engine-Running (KOER) ≥ 30 seconds SCR Warmup Not active.

		Inactive: SPN 27 FMI 14 (EGR); SPN 51 FMI 3, 4, 7 (ETP); SPN 94 FMI 3 and 4 (FDP); SPN 102 FMI 3, 4, 7, 16, and 18 (IMP); SPN 105 FMI 2, 3, 4 (IMT); SPN 108 FMI 3 and 4 (BARO); SPN 110 FMI 2, 3, and 4 (ECT); SPN 132 FMI 3 and 4 (MAF); SPN 164 FMI 0, 3, 4, 16, and 18 (ICP); SPN 175 FMI 2, 3, and 4 (EOT); SPN 636 FMI 2 and 7; SPN 651 FMI 4 and 5 (INJ); SPN 652 FMI 4 and 5 (INJ); SPN 653 FMI 4 and 5 (INJ); SPN 654 FMI 4 and 5 (INJ); SPN 655 FMI 4 and 5 (INJ); SPN 656 FMI 4 and 5 (INJ); SPN 679 FMI 3 and 4 (IPR); SPN 1173 FMI 16 (TC2CIT); SPN 1189 FMI 3 and 4 (TC2WC); SPN 1322 FMI 31(Engine); SPN 1323 FMI 31 (Engine); SPN 1324 FMI 31 (Engine); SPN 2659 FMI 20 and 21 (AMS); SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR); SPN 3055 FMI 2 (INJ); SPN 3242 FMI 3 and 4 (DPFIT); SPN 3246 FMI 3 and 4 (DPFOT); SPN 3464 FMI 31 (ETP); SPN 3471 FMI 1 and 7 (AFTPC); SPN 3479 FMI 3, 5, and 6 (AFTPC); SPN 3480 FMI 3 and 4 (AFTFIS); SPN 3482 FMI 3 and 4 (AFTFSV); SPN 3556 FMI 1 and 7 (AFTFP2); SPN 3936 FMI 2, 8, and 20 (DPF); SPN 4257 FMI 7 (INJ); SPN 4765 FMI 3 and 4 (DOCIT) ; SPN 4766 FMI 10 (DOCOT); SPN 5543 FMI 3, 4, and 5 (EBPV)

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Exhaust Gas Temperature (EGT) temperature is lower than expected more than 169°F (76°C)

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 27 FMI 14 (EGR)	• SPN 51 FMI 3, 4, 7 (ETP)	• SPN 94 FMI 3 and 4 (FDP)	• SPN 102 FMI 3, 4, 7, 16, and 18 (IMP)
• SPN 105 FMI 2, 3, 4 (IMT)	• SPN 108 FMI 3 and 4 (BARO)	• SPN 110 FMI 2, 3, and 4 (ECT)	• SPN 132 (MAF)
• SPN 164 FMI 0, 3, 4, 16, and 18 (ICP)	• SPN 172 (IAT)	• SPN 173 (EGT)	• SPN 175 FMI 2, 3, and 4 (EOT)
• SPN 188 FMI 0 and 1 (Engine)	• SPN 651 - 656 FMI 4 and 5 (INJ)	• SPN 679 FMI 3 and 4 (IPR)	• SPN 1173 FMI 16 (TC2CIT)
• SPN 1189 FMI 3 and 4 (TC2WC)	• SPN 1322 - 1328 FMI 31 (Engine)	• SPN 2630 (CACOT)	• SPN 2659 FMI 20 and 21 (AMS)
• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)	• SPN 3055 FMI 2 (INJ)	• SPN 3464 FMI 31 (ETP)	• SPN 3471 FMI 1 and 7 (AFTPC)
• SPN 3479 (AFTPC)	• SPN 3480 FMI 3 and 4 (AFTFIS)	• SPN 3482 FMI 3 and 4 (AFTFSV)	• SPN 3556 FMI 1 and 7 (AFTFP2)
• SPN 3936 (DPF)	• SPN 4257 FMI 7 (INJ)	• SPN 5395 FMI 0 and 1 (Engine)	• SPN 5543 FMI 3, 4, and 5 (EBPV)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Fuel restriction
- Degraded diesel fuel
- Failed Electric Fuel Pump (EFP)
- Failed fuel injector

Step 1	Check for associated faults	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1765). Is EST DTC list free of Associated Faults?	Yes: Go to step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4257 FMI 18.

Step 2	Check for active or pending fault	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 4257 FMI 18. Is EST DTC list SPN 4257 FMI 18 active or pending?	Yes: Go to step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Fuel System Inspection	Decision
	Perform Fuel System Inspection (page 2349). Are fuel lines, fuel filter, fuel strainer, and fuel connections clean and Not damaged?	Yes: Go to step 4.
		No: Repair Fuel lines, fuel strainer, and fuel connections. After repairs are complete, retest for SPN 4257 FMI 18.

Step 4	Fuel Quality Inspection	Decision
	Perform Fuel Quality inspection (page 2350). Is fuel free of water, waxing, icing, sediment, gasoline, kerosene, or Diesel Exhaust Fluid (DEF)?	Yes: Go to step 5.
		No: Drain fuel tank and fill with new and / or known good fuel. After repairs are complete, retest for SPN 4257 FMI 18.

Step 5	Fuel Delivery Pressure (FDP) Test	Decision
	Perform FDP Test (page 2273). Is FDP within specification?	Yes: Go to step 7.
		No: Go to step 6.

Step 6	Clean Fuel Source Test	Decision
	Perform Clean Fuel Source Test (page 2279). Is FDP within specification?	Yes: Repair Fuel restriction in fuel system. After repairs are complete, retest for SPN 4257 FMI 18.
		No: Replace Electric Fuel Pump (EFP). After repairs are complete, retest for SPN 4257 FMI 18.

Step 7	Multiple Cylinder Cutout Test	Decision
	Determine if engine has a fuel injector problem. Perform Cylinder Cutout Test (page 2184). Did one or more cylinders have significant speed difference(s) than the others?	Yes: Replace injector suspected by Cylinder Cutout Test. After repairs are complete, retest for SPN 4257 FMI 18.
		No: Retest for SPN 4257 FMI 18.

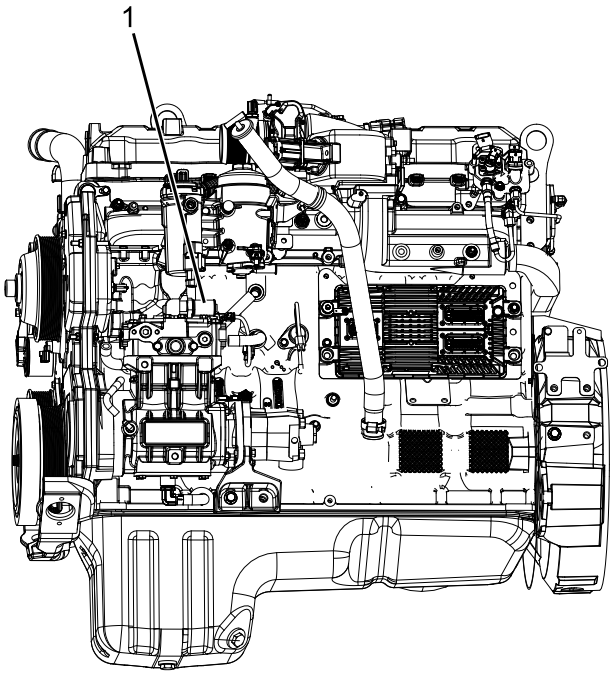
IPR (Injection Pressure Regulator)

Overview of IPR Sensor Group

SPN	FMI	Description
679	3	IPR short to PWR (page 1769)
679	4	IPR Open or short to GND (page 1773)

Overview

Injection Pressure Regulator (IPR) valve regulates oil pressure in high-pressure injection control pressure system. Injection Control Pressure (ICP) system intensifies fuel pressure in injectors. Engine Control Module (ECM) uses ICP sensor to monitor system pressure and adjusts IPR valve duty cycle to match engine requirements (starting, engine load, speed, and temperature).



0000061511

Figure 701 Injection Pressure Regulator (IPR) Location

1. IPR

SPN 679 FMI 3 - IPR Short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Injection Pressure Regulator (IPR) valve is shorted to power.	IPR valve frequency > 65,535 Hz	Key ON B+ ≥ 9 volts and ≤ 14 volts

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Injection Pressure Regulator (IPR) valve frequency is greater than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one trip.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IPR circuit short to PWR
- Failed IPR

Step 1	Check for active or pending fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 679 FMI 3 (IPR). Is EST DTC list SPN 679 FMI 3 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Injection Pressure Regulator (IPR) valve connector.	Decision
	A. Key OFF. B. Disconnect IPR valve connector. C. Check IPR valve and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IPR connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 679 FMI 3.

Pin-Point Tests (SPN 679 FMI 3)

IPR Circuit

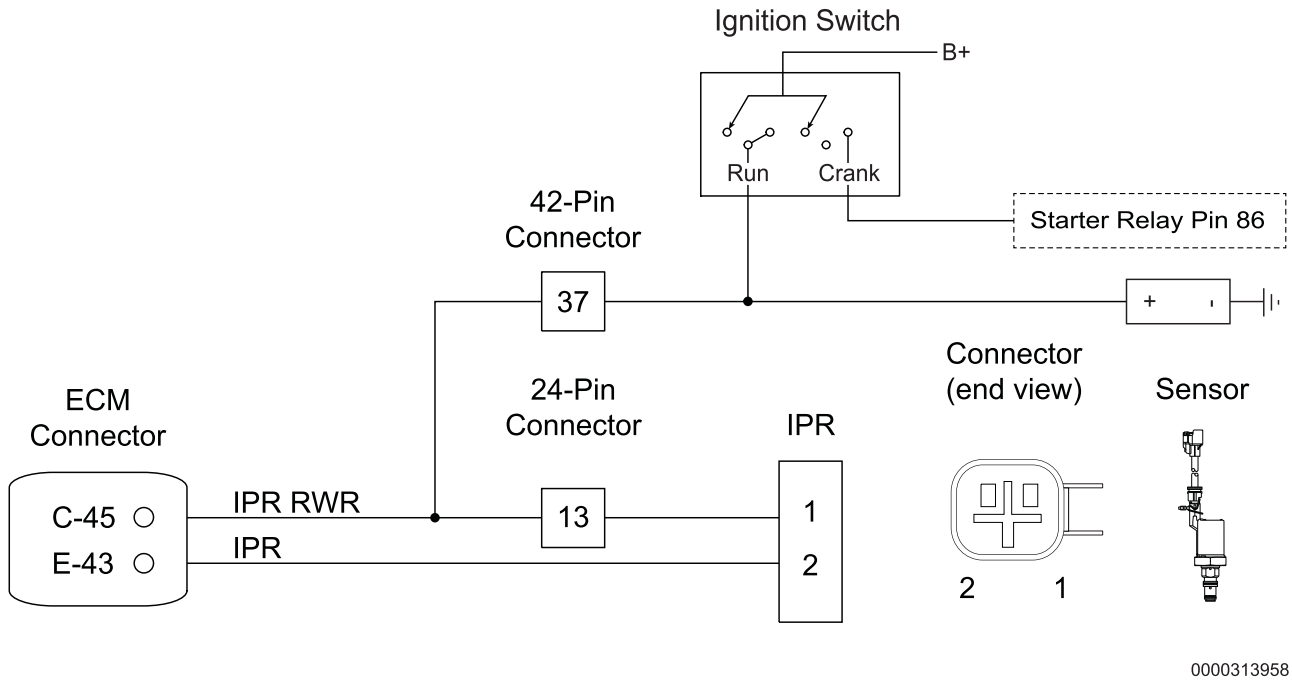


Figure 702 Injection Pressure Regulator (IPR) Valve Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Digital Multimeter (DMM)
- Injection Pressure Regulator (IPR) Breakout Harness 12-800-02

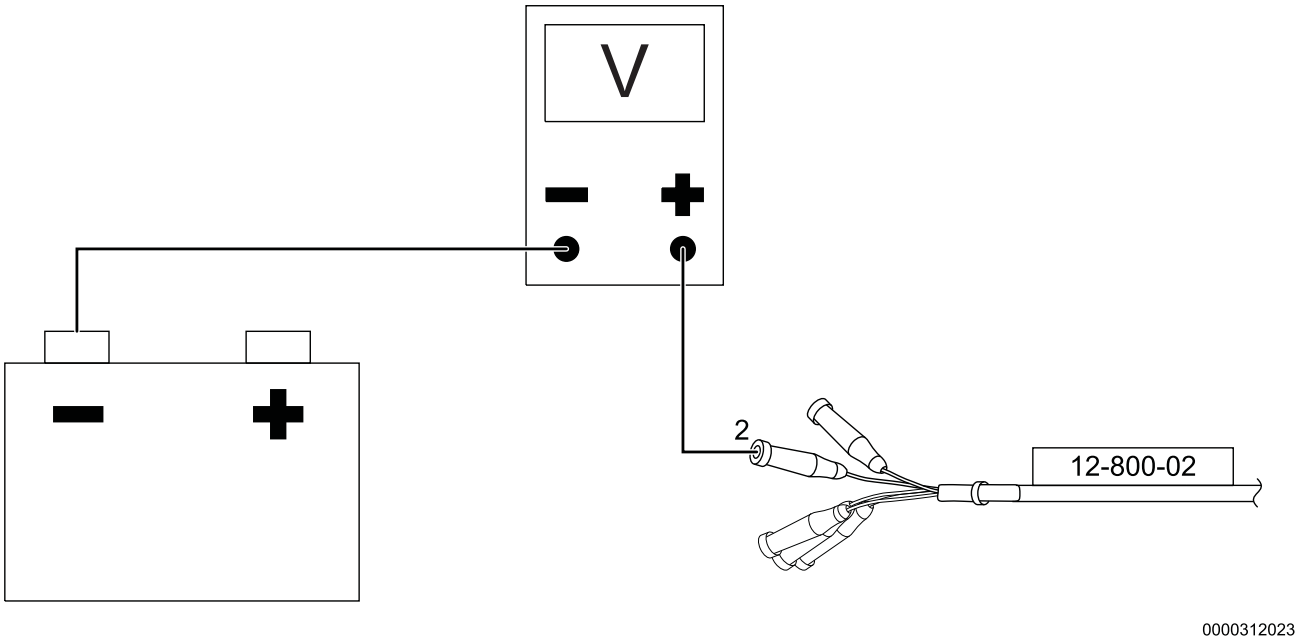


Figure 703 Test 1 Injection Pressure Regulator (IPR) Valve Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-800-02 to vehicle harness and leave Injection Pressure Regulator (IPR) valve disconnected. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 12-800-02 pin-2 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair short to PWR between IPR valve pin-2 and Engine Control Module (ECM) pin E-43. After repairs are complete, retest for SPN 679 FMI 3.
	No: Replace IPR valve. After repairs are complete, retest for SPN 679 FMI 3.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 679 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 679 FMI 4 - IPR Open or short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Injection Pressure Regulator (IPR) valve short to ground or open circuit	IPR valve frequency < 100 Hz	Key ON Battery Power ≥ 9 volts and ≤ 14 volts

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Injection Pressure Regulation (IPR) valve frequency is less than 100 Hz.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IPR ground side switch circuit Open
- IPR ground side switch circuit shorted to GND
- IPR PWR circuit Open
- Failed IPR valve

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 679 FMI 4 (IPR). Is EST DTC list SPN 679 FMI 4 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Injection Pressure Regulator (IPR) valve.	Decision
	A. Key OFF. B. Disconnect IPR valve connector. C. Check IPR valve and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IPR valve connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 679 FMI 4.

Pin-Point Tests (SPN 679 FMI 4)

IPR Circuit

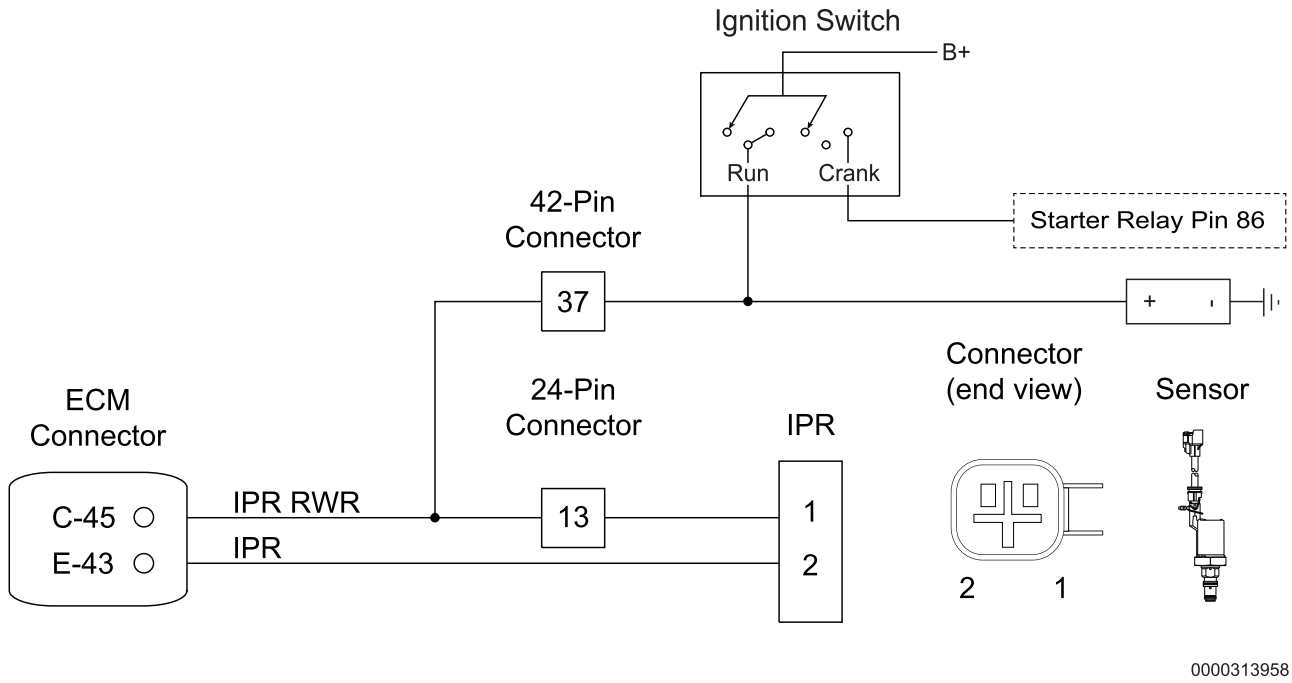


Figure 704 Injection Pressure Regulation (IPR) Valve Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Digital Multimeter (DMM)
- Breakout Harness 12-800-02

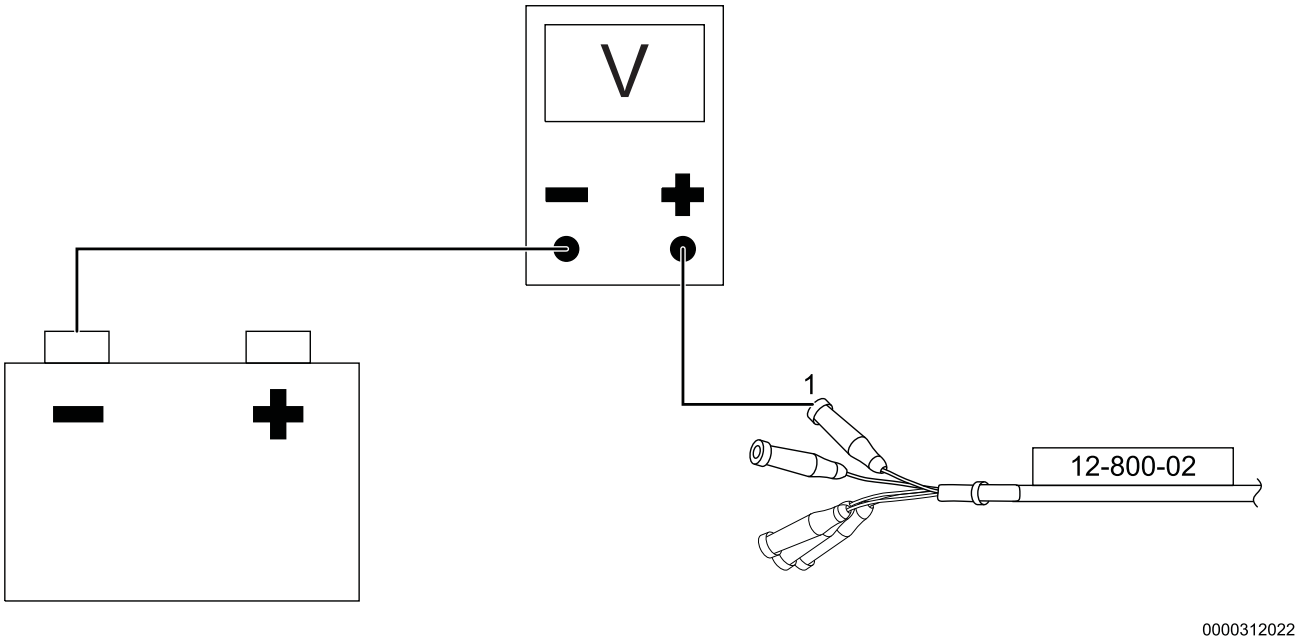


Figure 705 Test 1 Injection Pressure Regulation (IPR) Valve Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 12-800-02 to vehicle harness and leave Injection Pressure Regulator (IPR) valve disconnected. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 12-800-02 pin-1 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair Open between IPR valve pin-1 and Engine Control Module (ECM) pin C-45. After repairs are complete, retest for SPN 679 FMI 4.

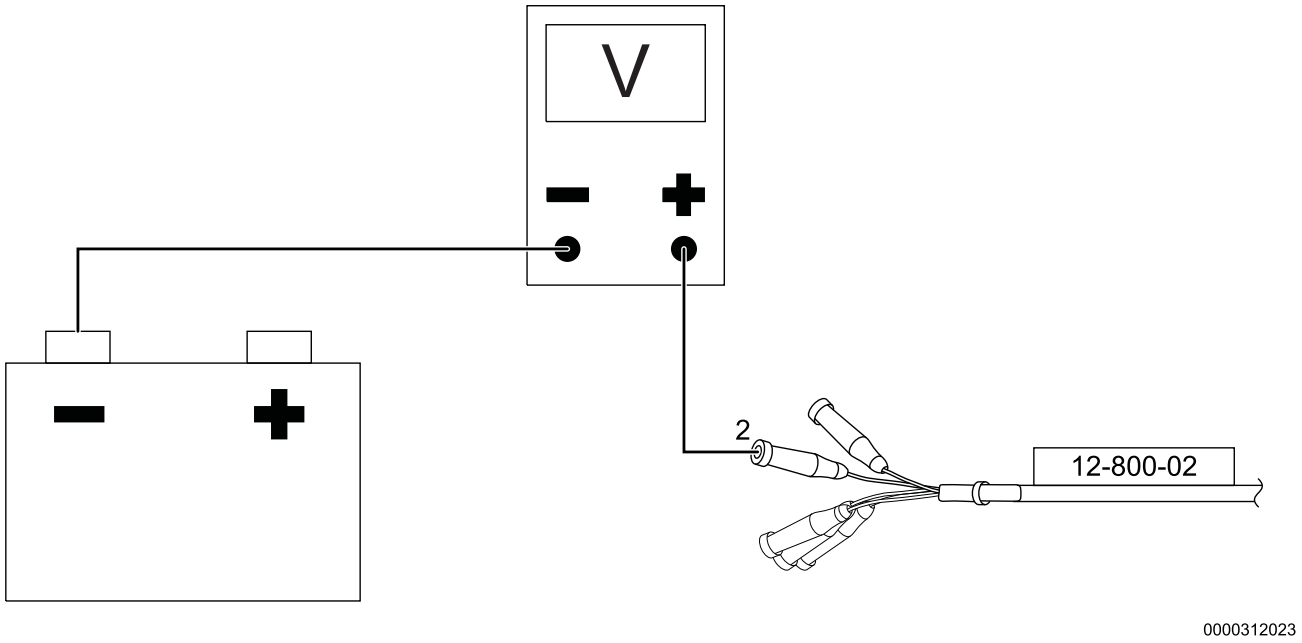


Figure 706 Test 2 Injection Pressure Regulation (IPR) Valve Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 12-800-02 to vehicle harness and leave IPR valve disconnected. C. KOEO.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 12-800-02 pin-2 and known good GND.	less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Go to Test 3.
	No: Replace IPR valve. After repairs are complete, retest for SPN 679 FMI 4.

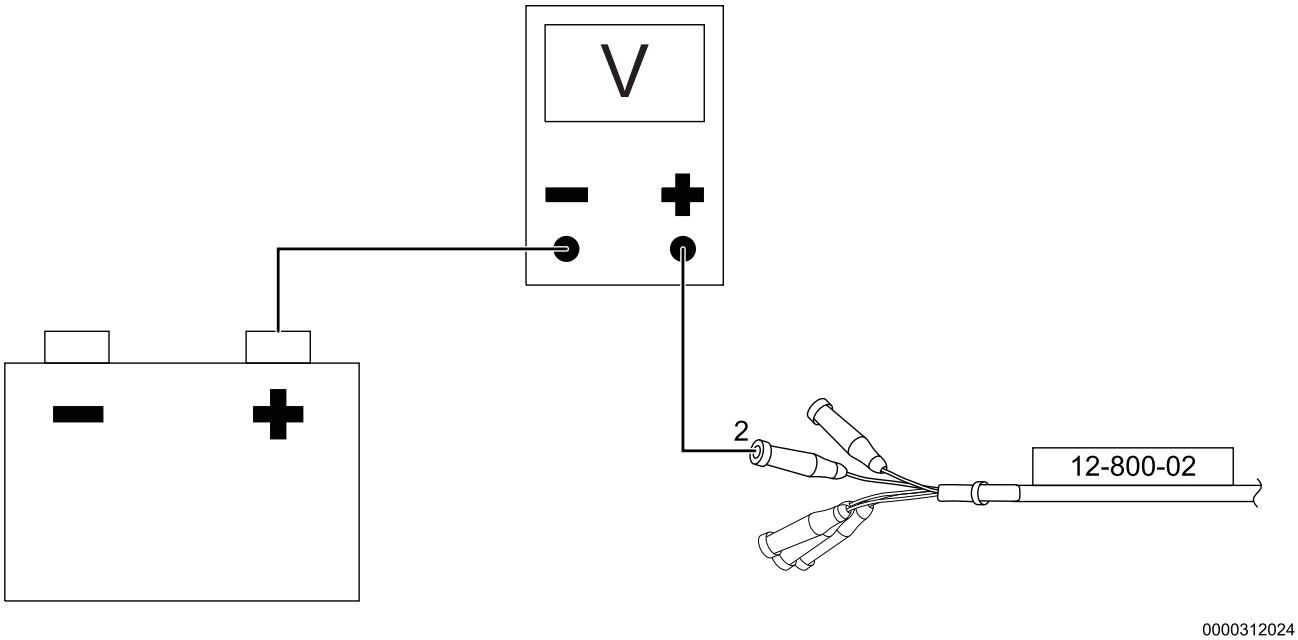


Figure 707 Test 3 Injection Pressure Regulation (IPR) Valve Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 12-800-02 to vehicle harness and leave Injection Pressure Regulation (IPR) valve disconnected. C. KOEO.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness 12-800-02 pin-2 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair short to GND between IPR valve pin-2 and Engine Control Module (ECM) pin E-43. After repairs are complete, retest for SPN 679 FMI 4.
	No: Repair Open circuit between IPR valve pin-2 and ECM pin E-43. After repairs are complete, retest for SPN 679 FMI 4.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 679 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

J1939 Data Link Communications

Overview of J1939 Sensor Group

SPN	FMI	Description
639	14	J1939 Data Link Error (ECM unable to transmit) (page 1780)

Overview

J1939 data link provides a communications link with all connecting modules. Electronic Service Tool (EST) uses this network system to communicate with Engine Control Module (ECM).

SPN 639 FMI 14 - J1939 Data Link Error (ECM unable to transmit)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
J1939 Data Link Error (Engine Control Module unable to transmit)	CAN1 bus off detected	Key ON CAN Bus Off diagnostic not inhibited
	CAN2 bus off detected	Key ON CAN Bus Off diagnostic not inhibited
	Message Electronic Transmission Control Unit_61442 {Missing communication between Engine Control Module and Electronic Transmission Control Unit} is NOT received for ≥ 5 seconds	Key ON Automatic Transmission recognized CAN Electronic Transmission Control Unit diagnostic not inhibited

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

- Short between CAN-AH and CAN-AL

Step 2	Inspect connections at Mass Air Flow (MAF) connector.	Decision
	A. Key OFF. B. Disconnect MAF connector. C. Check MAF and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are MAF connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 639 FMI 14.

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

MAF Sensor (Mass Air Flow)

Overview of MAF Sensor Group

SPN	FMI	Description
132	0	Engine Intake Air Mass Flow Rate High (page 1783)
132	1	Engine Intake Air Mass Flow Rate Low (page 1787)
132	4	MAF signal Out of Range LOW (page 1790)
132	11	MAF Sensor Calibration – Insufficient number of data points (page 1794)
132	13	MAF Sensor Calibration Needed (page 1796)
132	14	MAF Sensor Calibration Failed (page 1798)
132	31	MAF Frequency out of range HIGH (page 1800)
172	2	IAT Signal Erratic, Intermittent, or Incorrect (page 1812)
172	3	IAT signal Out of Range HIGH (page 1817)
172	4	IAT Signal Out of Range LOW (page 1823)

Overview

Mass Air Flow (MAF) sensor directly monitors air entering engine. MAF sensor also houses Air Intake Temperature (AIT) sensor, which is used with MAF to calculate amount and density of incoming air. Engine Control Module (ECM) uses this information to calculate correct amount of Exhaust Gas Recirculation (EGR) during engine operation.

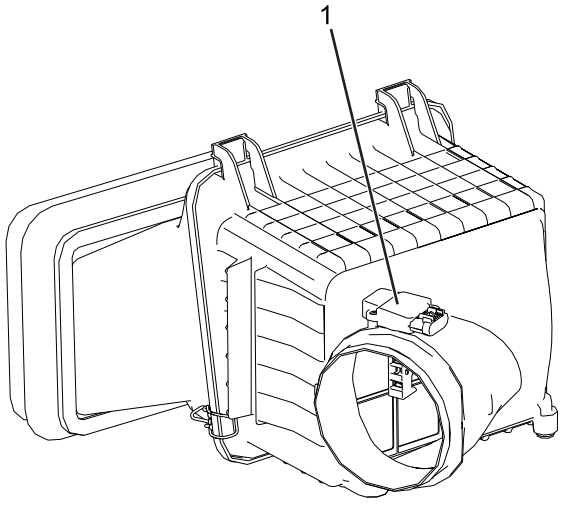


Figure 708 MAF (Mass Air Flow) Sensor Location

1. MAF / AIT sensor

SPN 132 FMI 0 - Engine Intake Air Mass Flow Rate High

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of modeled Engine Intake Air Mass Flow rate with actual Engine Intake Air Mass flow rate {Engine Intake Air Mass Flow Rate High}	Moving Mean average of measured Engine Intake Air Mass Flow rate MINUS Modeled value of Engine Intake Air Mass Flow rate > Threshold defined by Speed/Torque based table [Table A055]* Ambient pressure modifier table [Table A056] * Engine coolant temperature modifier table [Table A057]	Key ON Engine Running Time after engine start ≥ 30 seconds Particulate Filter Regeneration NOT Active Selective Catalytic Reduction (SCR) Warm-up NOT Active Engine Coolant Temperature > 68°F (20°C) AND < 219°F (104°C) Barometric Absolute Pressure ≥ 10.7 psi (73.5 kPa) AND ≤ 14.9 psi (103 kPa) Monitor entry condition based on speed-torque table [Table A115] Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] > 5 seconds Engine Torque limitation NOT Active Engine is in NOT in coasting (i.e. Throttle Cut OFF) mode Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Engine Coolant Temperature ≥ 104°F (40°C) 1. Engine Speed Gradient ≤ 50 RPM/sec 2. Engine Torque Gradient ≤ 32 N·m/sec 3. Absolute Engine Intake Manifold #1 Pressure Gradient ≤ 25.04 * 5 kPa/sec Minimum time in entry conditions 1, 2, and 3 (listed above) to enable monitoring ≥ 200 * 0.02 seconds SPN/FMI 102/3, 102/4, 105/3, 105/4, 108/3, 108/4, 110/3, 110/4, 132/3, 132/4, 2791/3, 2791/4, 2791, 3509/3, 3509/4 are NOT Active

Fault Overview

Fault sets when Engine Control Module (ECM) detects engine intake air mass flow rate is high, by comparing modeled engine intake air mass flow rate with actual engine intake air mass flow rate.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 27 FMI 0 and 14 (EGR)	• SPN 132 FMI 3 and 4 (MAF)	• SPN 2791 FMI 2, 3, 4, 7, 8, and 14 (EGR)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Disconnected CAC hoses or tubes after turbochargers
- Water ingestion in air cleaner
- MAF out of calibration
- EGR valve fault

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1784). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 132 FMI 0.

Step 2	Inspect air intake system and air filter for restrictions, air leaks, or physical damage.	Decision
	Do Intake Air Inspection (page 2365) and Charge Air Cooler (CAC) System Inspection (page 2363). Is air intake system and air filter free of restrictions, leaks, and physical damage?	Yes: Go to Step 3.
		No: Repair intake air system or replace air filter. After repairs are complete, retest for SPN 132 FMI 0.

Step 3	Inspect air intake system and air filter for restrictions, air leaks, or physical damage.	Decision
	Inspect Mass Air Flow (MAF) and intake ducting for signs of water. Are signs of water found in MAF or intake ducting?	Yes: Repair water leak into MAF and intake ducting. After repairs are complete, retest for SPN 132 FMI 0.
		No: Go to step 4.

Step 4	Test Exhaust Gas Recirculation (EGR) valve operation.	Decision
	Using EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear (minimum of 45 seconds). C. Key ON, perform KOEO Output State High and Low (page 2145) four times while waiting 30 seconds for each test to run. Check for SPN 2791 FMI 7 or SPN 2791 FMI 14 fault setting after the fourth Output State High test. Is EST DTC list free of SPN 2791 FMI 7 or SPN 2791 FMI 14?	Yes: Perform KOER MAF sensor calibrations(page 2268). After repairs are complete, retest for SPN 132 FMI 0.
		No: Replace EGR valve. After repairs are complete, retest for SPN 132 FMI 0.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 132 FMI 0 fault code diagnostics.

SPN 132 FMI 1 - Engine Intake Air Mass Flow Rate Low

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Comparison of modeled Engine Intake Air Mass Flow rate with actual Engine Intake Air Mass flow rate {Engine Intake Air Mass Flow Rate Low}	Moving Mean average of measured Engine Intake Air Mass Flow rate MINUS Modeled value of Engine Intake Air Mass Flow rate < (Speed/Torque [Table A058] Ambient pressure modifier [Table A059] Engine coolant temperature modifier [Table A060]	Key - ON Engine – Running (KOER) ≥ 30 seconds Diesel Particulate Filter (DPF) Regeneration NOT Active Selective Catalytic Reduction (SCR) Warm-up NOT Active Engine Coolant Temperature ≥ 104°F (40°C) AND < 219°F (104°C) Barometric Absolute Pressure ≥ 10.7 psi (73.5 kPa) AND ≤ 14.9 psi (103 kPa) Power Take Off (PTO) Mode NOT Active End Of Line Testing NOT Active Engine Brake (Retarder) NOT active > 5 seconds Engine Torque limitation NOT Active Engine is in NOT in coasting (i.e. Throttle Cut OFF) mode Minimum time in entry conditions 1, 2, and 3 (listed below) to enable monitoring ≥ 4 seconds 1. Engine Speed Gradient ≤ 50 RPM/sec 2. Engine Torque Gradient ≤ 32 N·m/sec 3. Absolute Engine Intake Manifold #1 Pressure Gradient ≤ 25.04 * 5 kPa/sec) Inactive: SPN 102 FMI 3, 4 (IMP); SPN 105 FMI 3, 4 (IMT); SPN 108 FMI 3, 4 (BARO); SPN 110 FMI 3, 4 (ECT1); SPN 132 FMI 3, 4 (MAF); SPN 2791 FMI 3, 4 (EGR); SPN 3509 FMI 3, 4 (VREF1).

Fault Overview

Fault sets when Engine Control Module (ECM) detects engine intake air mass flow rate is low, by comparing modeled engine intake air mass flow rate with actual engine intake air mass flow rate.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 132 FMI 3 and 4 (MAF)	• SPN 2791 (EGR)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Road test

Possible Causes

- Disconnected hose to air filter
- Restricted air filter
- Restricted CAC or plumbing
- Failed turbochargers

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1788). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 132 FMI 1.

Step 2	Inspect air intake system and air filter for restrictions, air leaks, or physical damage.	Decision
	Do Intake Air Inspection (page 2365). Is air intake system and air filter free of restrictions, leaks, and physical damage?	Yes: Go to Step 3.
		No: Repair intake air system or replace air filter. After repairs are complete, retest for SPN 132 FMI 1.

Step 3	Inspect CAC system for restrictions, air leaks, or physical damage.	Decision
	Do Charge Air Cooler (CAC) System Inspection (page 2363). Is CAC system free of restrictions, leaks, and physical damage?	Yes: Go to Step 4.
		No: Repair CAC system. After repairs are complete, retest for SPN 132 FMI 1.

Step 4	Test Turbocharger 2 Wastegate Control (TC2WC) for proper operation.	Decision
	Perform TC2WC Solenoid test(page 2263). Does wastegate operate properly?	Yes: Perform KOER MAF sensor calibrations(page 2268). After repairs are complete, retest for SPN 132 FMI 1.
		No: Repair TC2WC as indicated by TC2WC tests. After repairs are complete, retest for SPN 132 FMI 1.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 132 FMI 1 fault code diagnostics.

SPN 132 FMI 4 - MAF signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Air Mass Flow signal Out of Range Low	Engine Intake Air Mass Flow sensor Time Period < 0.00006 seconds	Key ON Battery Voltage > 9 Volts Computed battery voltage > 9 Volts Engine Speed ≥ 0 RPM

Fault Overview

Fault sets when engine Mass Air Flow (MAF) signal is out of range low.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- MAF signal circuit short to GND
- Failed MAF sensor

Step 1	Inspect air intake system and air filter for restrictions, air leaks, or physical damage.	Decision
	Do Intake Air Inspection(page 2365) and Charge Air Cooler (CAC) System Inspection(page 2363). Is air intake system and air filter free of restrictions, leaks, and physical damage?	Yes: Go to Step 2.
		No: Repair intake air system or replace air filter. After repairs are complete, retest for SPN 132 FMI 4.

Step 2	Inspect connections at Mass Air Flow (MAF) connector.	Decision
	A. Key OFF. B. Disconnect MAF connector. C. Check MAF and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are MAF connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests .
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 132 FMI 4.

Step 3	Test Turbocharger 2 Wastegate Control (TC2WC) for proper operation.	Decision
	Perform Turbocharger 2 Wastegate Position (TC2WG) Operational Test(page 2259). Does wastegate operate properly?	Yes: Perform KOER MAF Sensor Calibrations(page 2268).
		No: Repair TC2WC as indicated by TC2WC tests. After repairs are complete, retest for SPN 132 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 132 FMI 4 fault code diagnostics.

Pin-Point Tests (SPN 132 FMI 4)

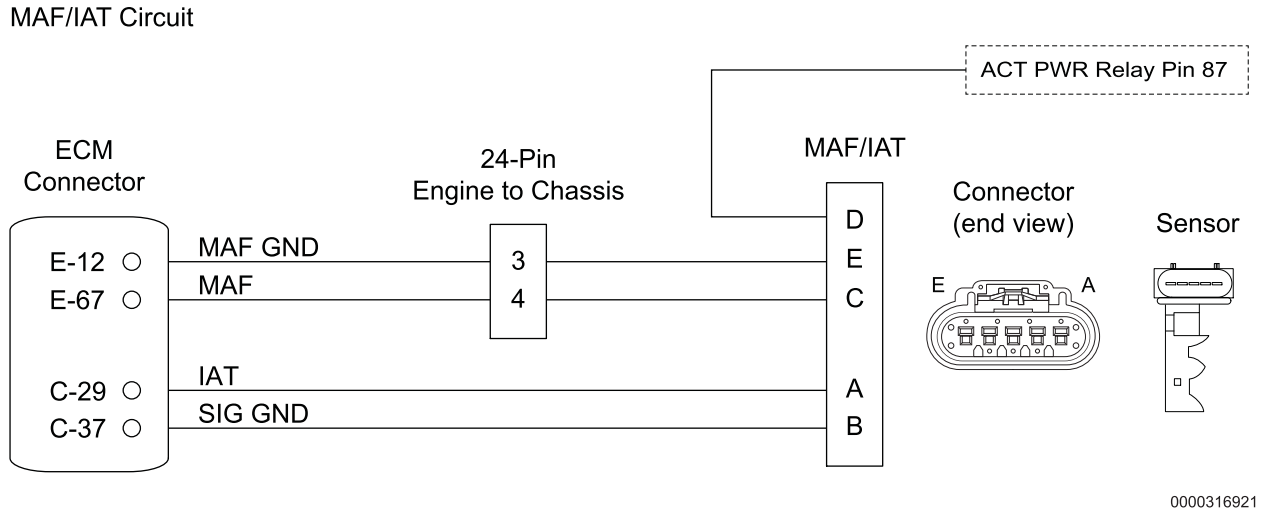


Figure 709 Mass Air Flow (MAF) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4960
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM)

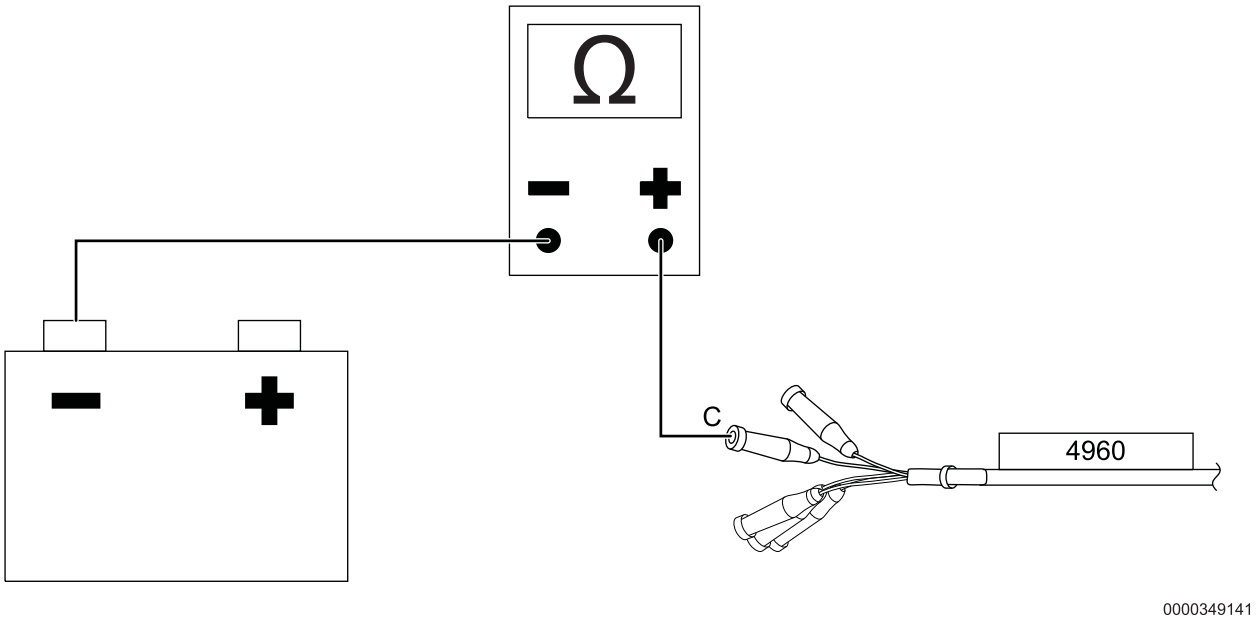


Figure 710 Test 1 MAF Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 1	Specification
Using DMM measure resistance between Breakout Harness ZTSE4960 pin-C and known good GND.	Greater than 10,000 ohms
Decision	
Is resistance greater than 10,000 ohms?	Yes: Go to Step 3.
	No: Repair short to GND in MAF circuit. After repairs are complete, retest for SPN 132 FMI 4.

SPN 132 FMI 11 - MAF Sensor Calibration – Insufficient number of data points

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Mass Air Flow (MAF) sensor auto-calibration has not completed successfully.	MAF auto-calibration has insufficient number of data points	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects MAF sensor did not successfully complete an auto-calibration routine.

Lamp Reaction

Amber Warning Lamp (AWL) illuminates when this fault is detected.

Associated Faults

None

Fault Facts

When MAF auto-calibration routine does not successfully complete, MAF sensor will need to be re-calibrated.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Improperly calibrated MAF

Step 1	Run MAF sensor calibration.	Decision
	Perform MAF Sensor Calibration (SPN 132 FMI 13 - MAF Sensor Calibration Needed, page 1796) and clear fault code. Cycle ignition to Key OFF, then back to Key ON. Does SPN 132 FMI 11 set after DTC list is cleared?	Yes: Replace MAF sensor. After repairs are complete, retest MAF sensor. No: Diagnostics complete.

End Diagnostic Step
After performing diagnostic step, if SPN 132 FMI 11 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 132 FMI 13 - MAF Sensor Calibration Needed

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Mass Air Flow (MAF) sensor needs to be re-calibrated after Engine Control Module (ECM) reprogramming.	ECM reprogrammed without re-calibrating the MAF.	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) has been reprogrammed and Mass Air Flow (MA)F sensor needs to be re-calibrated.

Lamp Reaction

Amber Warning Lamp (AWL) illuminates when this fault is detected.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON

Possible Causes

- Improperly calibrated MAF

Step 1	Run MAF sensor calibration and check for fault code.	Decision
	Perform MAF Sensor Calibration (page 2268) and clear fault code. Cycle ignition to Key OFF, then back to Key ON. Does SPN 132 FMI 13 set after DTC list is cleared?	Yes: Replace MAF sensor. After repairs are complete, retest MAF sensor.
		No: Diagnostics complete.

End Diagnostic Step
After performing diagnostic step, if SPN 132 FMI 13 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 132 FMI 14 - MAF Sensor Calibration Failed

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

See 2010 MaxxForce® DT, 9, and 10 Engines Diagnostic Manual 0000001624 for information on this fault code.

SPN 132 FMI 31 - MAF Frequency out of range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Engine Intake Air Mass Flow Rate Short to Power, Short to GND or Open Circuit	Falling edges detected by Pulse Input Measurement driver (Mass Air Flow sensor frequency) > 60 %	Key ON Battery Voltage > 9 Volts Computed battery voltage > 9 Volts Engine Speed ≥ 0 RPM

Fault Overview

Fault sets when Engine Control Module (ECM) detects a short to PWR, short to GND, or an Open circuit in Mass Air Flow (MAF) sensor.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open or high resistance in ACT PWR circuit
- Open or high resistance in MAF GND circuit
- Open or high resistance in MAF circuit
- Short to GND in MAF circuit
- Short to PWR in MAF circuit
- Failed MAF

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 132 FMI 31. Is EST DTC list SPN 132 FMI 31 active or pending?	Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Mass Air Flow (MAF) connector.	Decision
	A. Key OFF. B. Disconnect MAF connector. C. Check MAF and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are MAF connector, harness, and terminals clean and undamaged?	Yes: Go to Step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 132 FMI 31.

Step 3	Inspect connections at 24-Pin Engine to Chassis connector.	Decision
	A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Check 24-Pin Engine to Chassis and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are 24-Pin Engine to Chassis connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 132 FMI 31.

Pin-Point Tests (SPN 132 FMI 31)

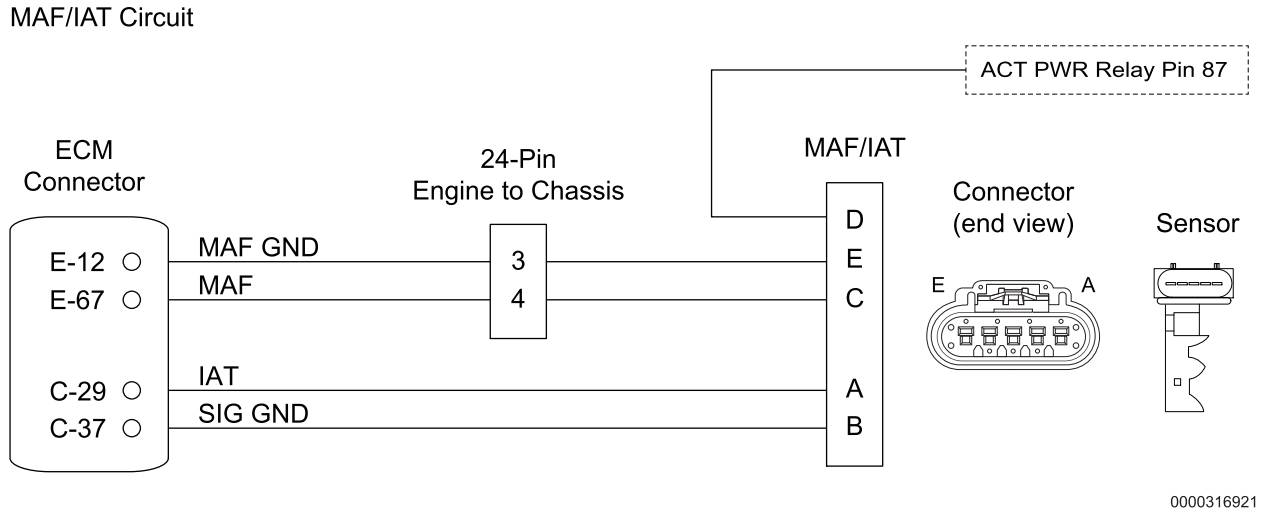
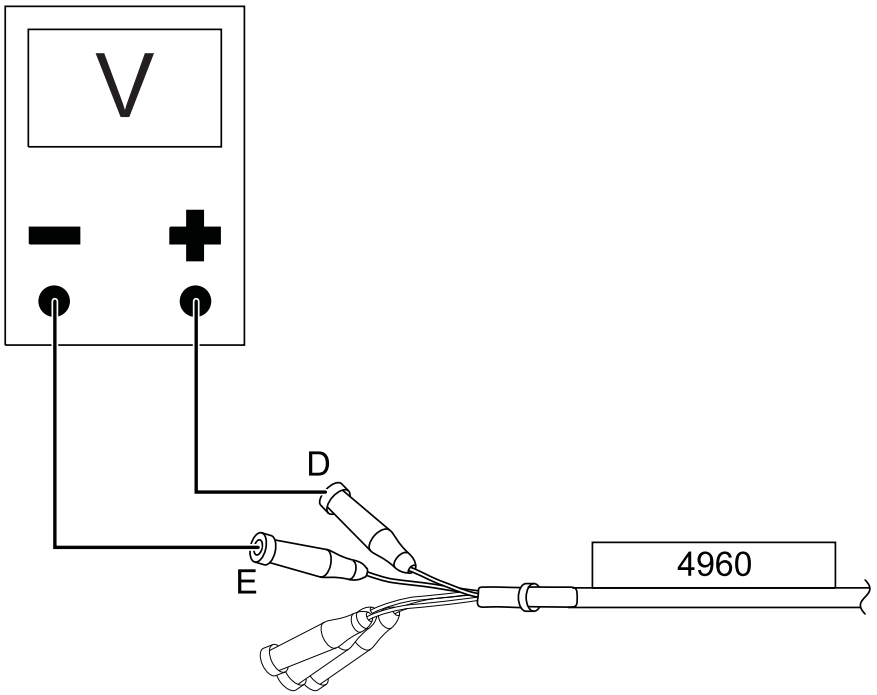


Figure 712 Mass Air Flow (MAF) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4960
- Breakout Harness ZTSE6020
- Digital Multimeter (DMM)



0000341221

Figure 713 Test 1 MAF Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 1	Specification
Using DMM measure voltage between Breakout Harness ZTSE4960 pin-D and pin-E.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 4.
	No: Go to Test 2.

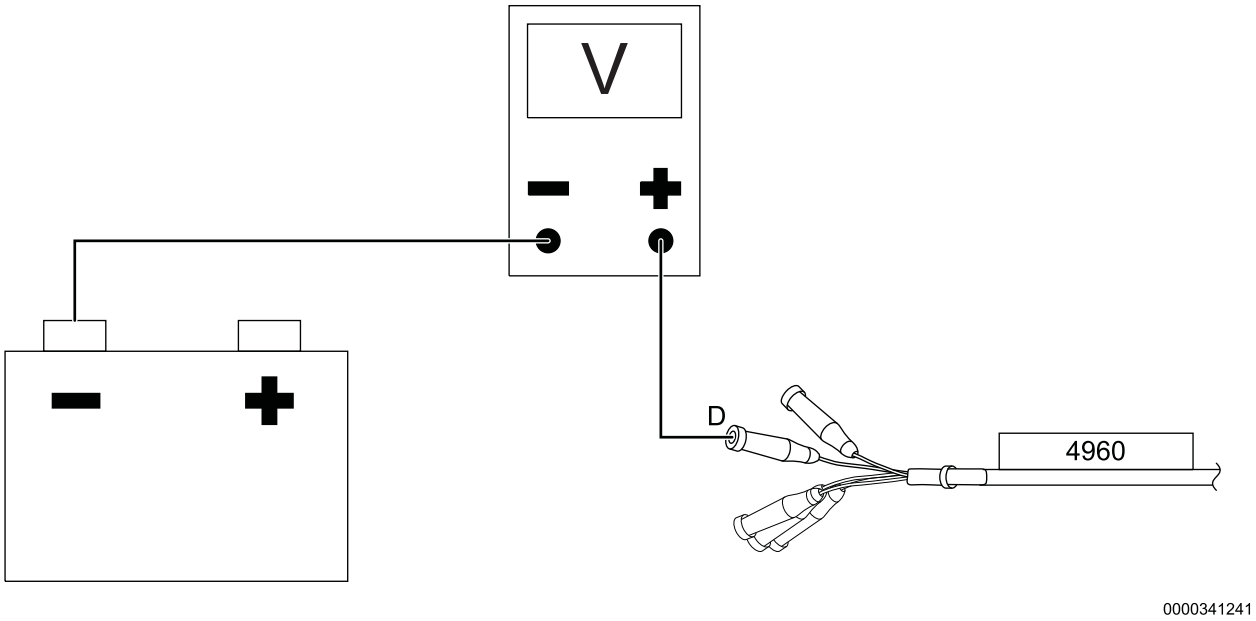


Figure 714 Test 2 MAF Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 2	Specification
Using DMM measure voltage between Breakout Harness ZTSE4960 pin-D and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Repair ACT PWR circuit. After repairs are complete, retest for SPN 132 FMI 31.

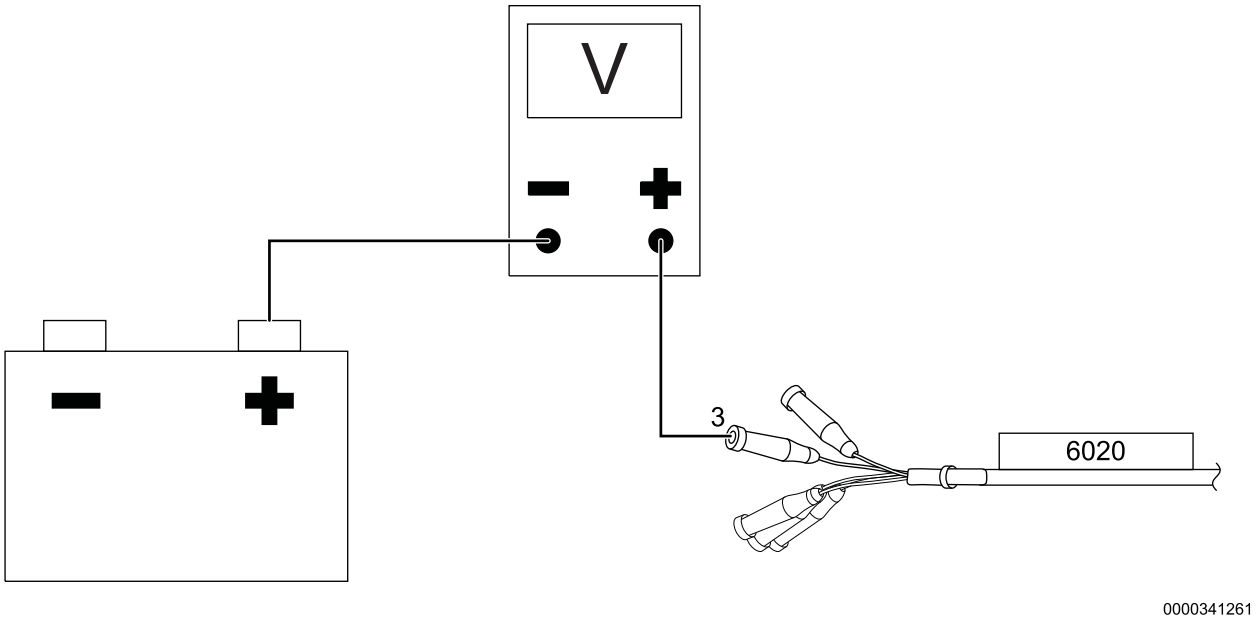


Figure 715 Test 3 MAF Signal Circuit Check

Test 3 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis connector disconnected. D. Key ON.

Test 3	Specification
Using DMM measure voltage between Breakout Harness ZTSE6020 pin-3 and B+.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair open in MAF GND circuit between 24-Pin Engine to Chassis connector pin-3 and MAF pin-E. After repairs are complete, retest for SPN 132 FMI 31.
	No: Repair open in MAF GND circuit between ECM pin E-12 and 24-Pin Engine to Chassis connector pin-3. After repairs are complete, retest for SPN 132 FMI 31.

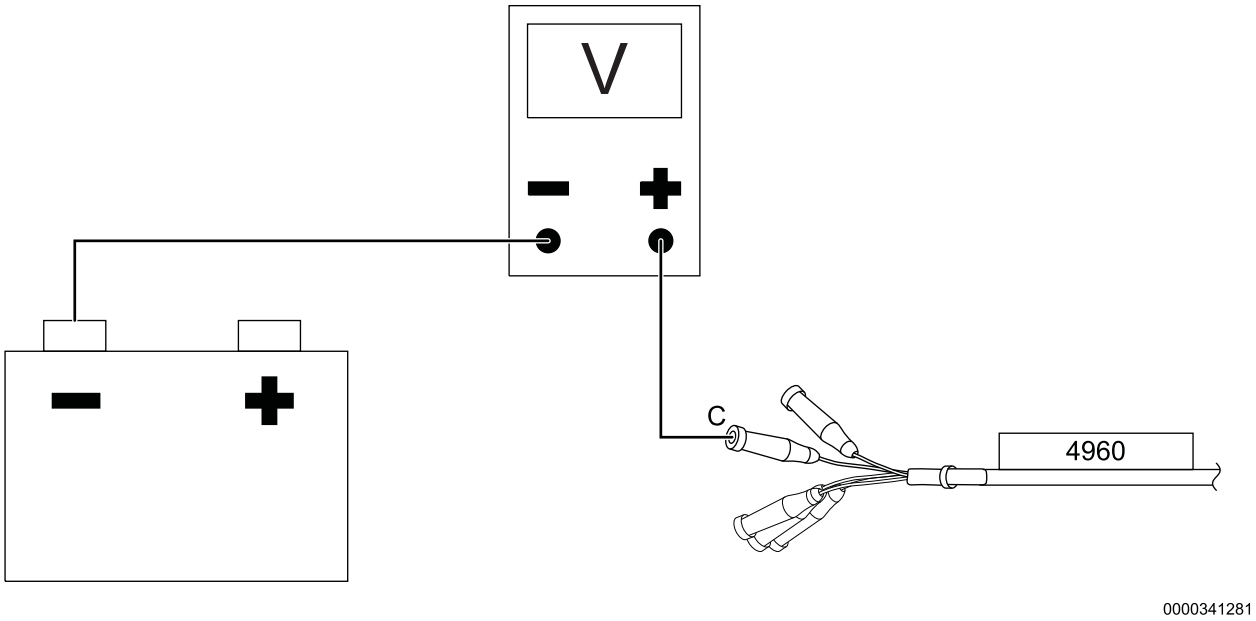
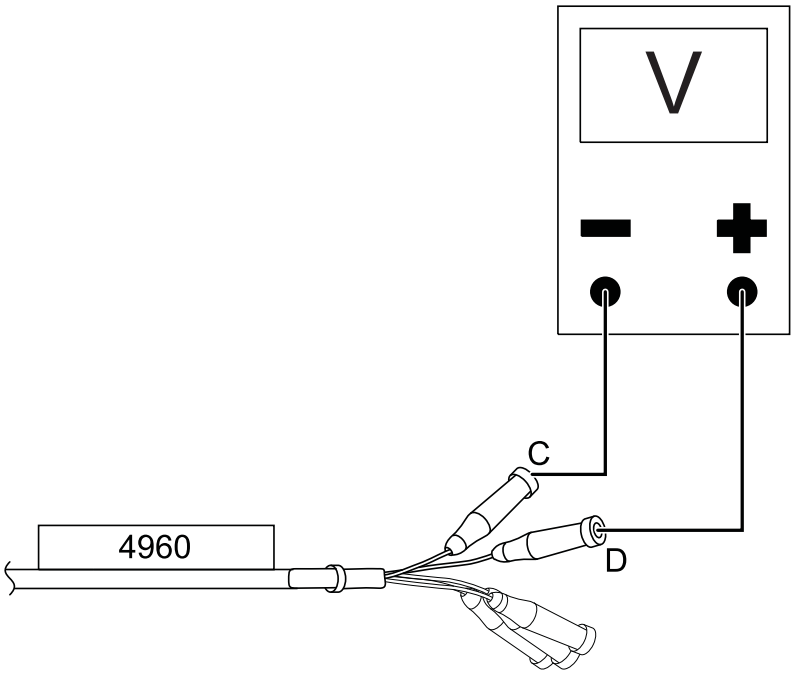


Figure 716 Test 4 MAF Signal Circuit Check

Test 4 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 4	Specification
Using DMM measure voltage between Breakout Harness ZTSE4960 pin-C and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Replace MAF. After repairs are complete, retest for SPN 132 FMI 31.
	No: Go to Test 5.

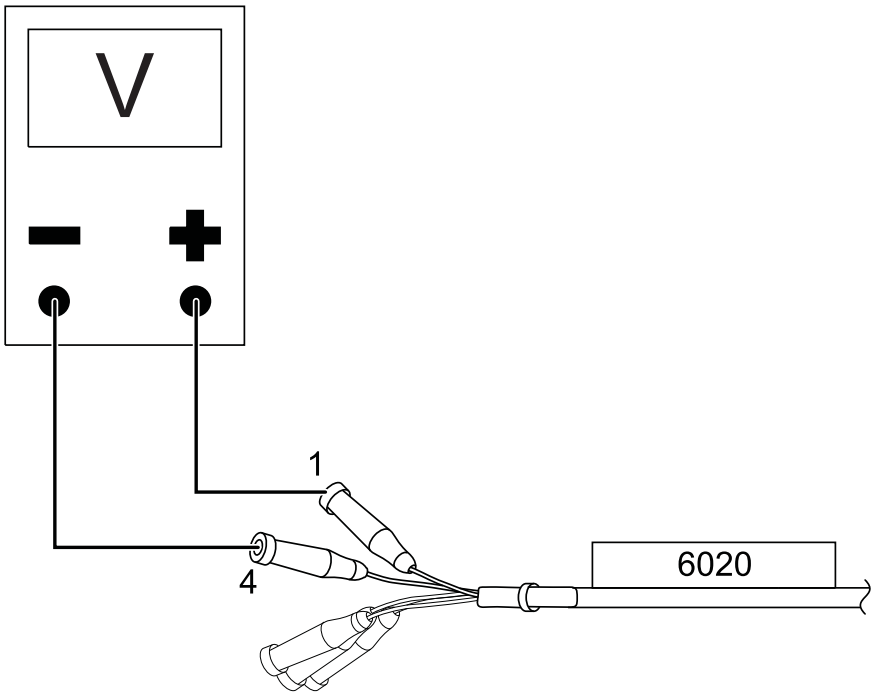


0000341301

Figure 717 Test 5 MAF Signal Circuit Check

Test 5 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 5	Specification
Using DMM measure voltage between Breakout Harness ZTSE4960 pin-D and pin-C.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 6.
	No: Go to Test 7.



0000341321

Figure 718 Test 6 MAF Signal Circuit Check

Test 6 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis connector disconnected. D. Key ON.

Test 6	Specification
Using DMM measure voltage between Breakout Harness ZTSE6020 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair short to GND in MAF circuit between ECM pin E-67 and 24-Pin Engine to Chassis connector pin-4. After repairs are complete, retest for SPN 132 FMI 31.
	No: Repair short to GND in MAF circuit between 24-Pin Engine to Chassis connector pin-4 and MAF pin-C. After repairs are complete, retest for SPN 132 FMI 31.

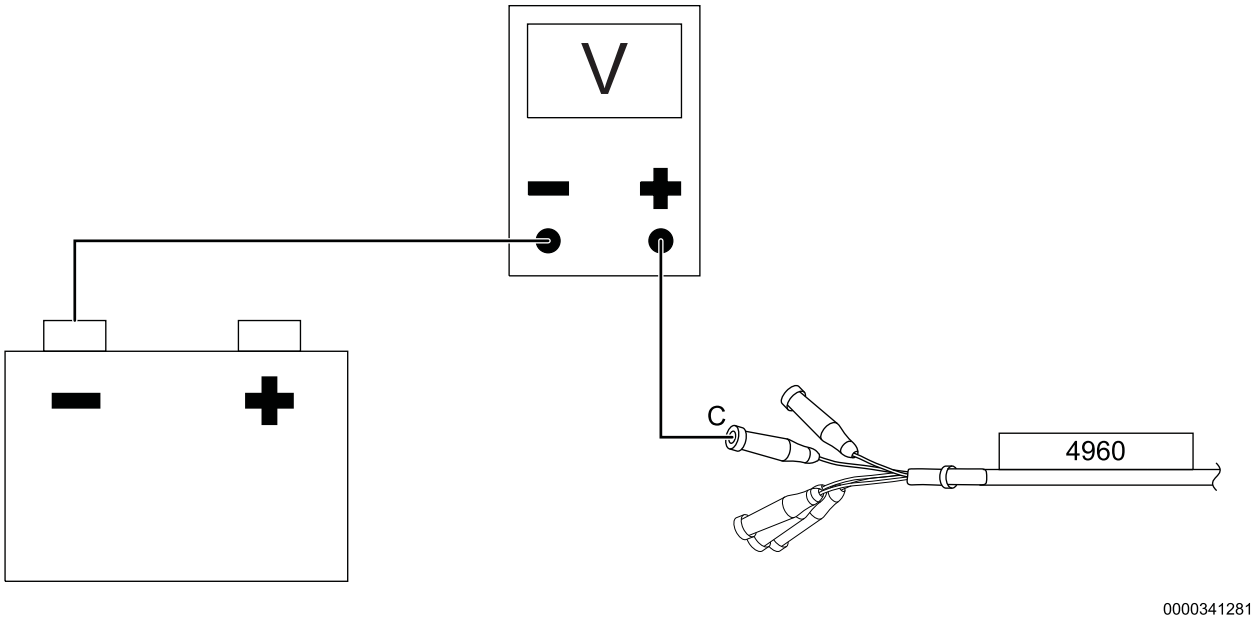


Figure 719 Test 7 MAF Signal Circuit Check

Test 7 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness and leave MAF sensor disconnected. D. Key ON.

Test 7	Specification
Using DMM measure voltage between Breakout Harness ZTSE4960 pin-C and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage greater than 5.5 volts?	Yes: Go to Test 9.
	No: Go to Test 8.

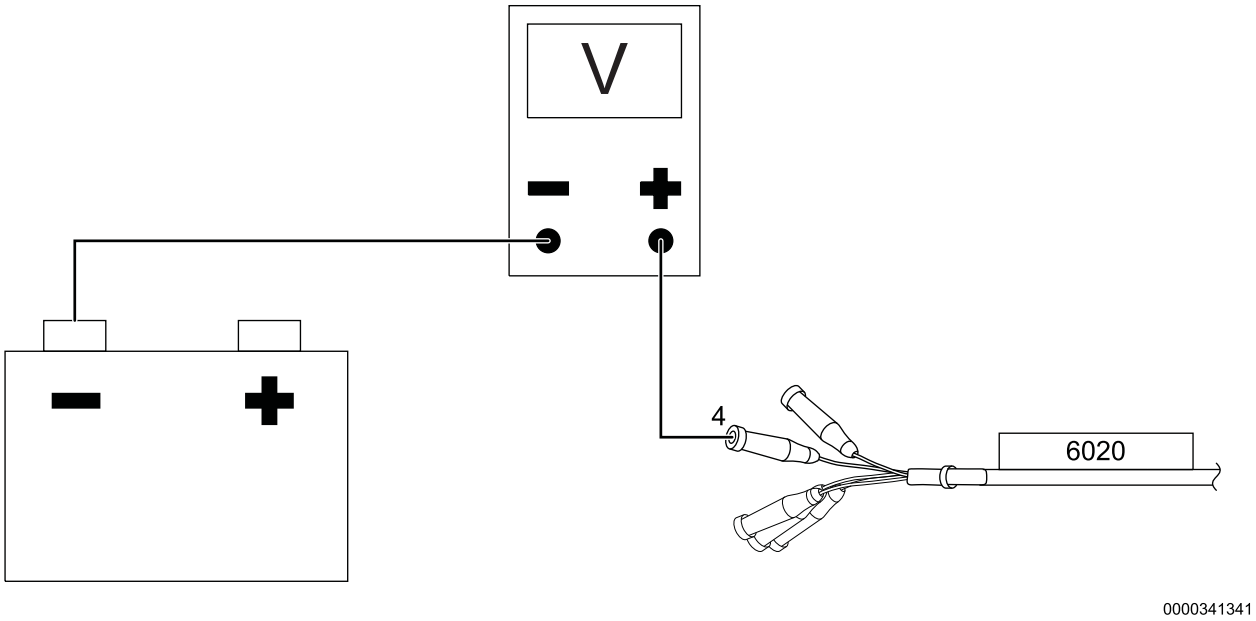


Figure 720 Test 8 MAF Signal Circuit Check

Test 8 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis connector disconnected. D. Key ON.

Test 8	Specification
Using DMM measure voltage between Breakout Harness ZTSE6020 pin-4 and known good GND.	5 ± 0.5 volts
Decision	
Is voltage 5 ± 0.5 volts?	Yes: Repair open in MAF circuit between 24-Pin Engine to Chassis connector pin-4 and MAF pin-C. After repairs are complete, retest for SPN 132 FMI 31.
	No: Repair open in MAF circuit between ECM pin E-67 and 24-Pin Engine to Chassis connector pin-4. After repairs are complete, retest for SPN 132 FMI 31.

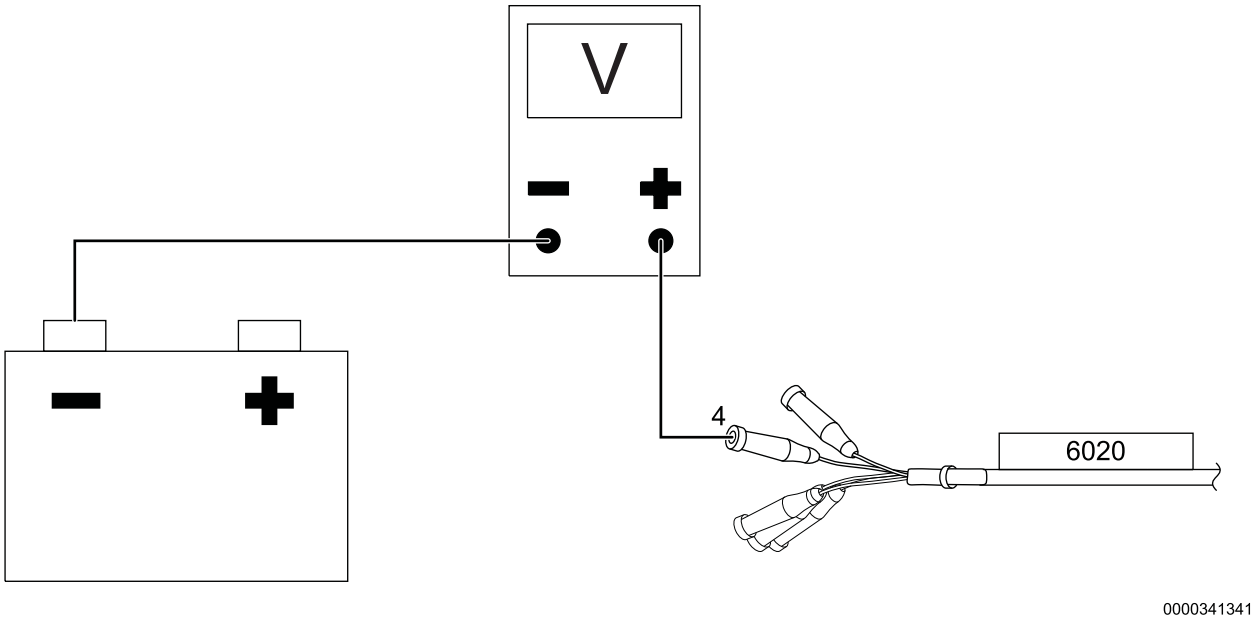


Figure 721 Test 9 MAF Signal Circuit Check

Test 9 Setup
A. Key OFF. B. Disconnect 24-Pin Engine to Chassis connector. C. Connect Breakout Harness ZTSE6020 to vehicle harness and leave 24-Pin Engine to Chassis connector disconnected. D. Key ON.

Test 9	Specification
Using DMM measure voltage between Breakout Harness ZTSE6020 pin-4 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair short to PWR in MAF circuit between ECM pin E-67 and 24-Pin Engine to Chassis connector pin-4. After repairs are complete, retest for SPN 132 FMI 31.
	No: Repair short to PWR in MAF circuit between 24-Pin Engine to Chassis connector pin-4 and MAF pin-C. After repairs are complete, retest for SPN 132 FMI 31.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 132 FMI 31 fault code diagnostics.

SPN 172 FMI 2 - IAT Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Temperature (IAT) does not agree with other sensors	Difference between IAT sensor and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, TC2CIT, IMT, CACOT, and EOT are all within 59°F (15°C) of each other

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that difference between Intake Air Temperature (IAT) sensor reading and other temperature sensor reading is greater than 59°F (15°C)

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 172 FMI 3 and 4 (IAT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (After Cold Soak)

Possible Causes

- Failed IAT sensor
- High resistance in IAT circuit
- High resistance in SIG GND circuit

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1812). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 172 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 172 FMI 2. Is EST DTC list SPN 172 FMI 2 active or pending?	Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Intake Air Temperature (IAT) connector.	Decision
	A. Key OFF. B. Disconnect IAT connector. C. Check IAT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are IAT connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 172 FMI 2.

Pin-Point Tests (SPN 172 FMI 2)

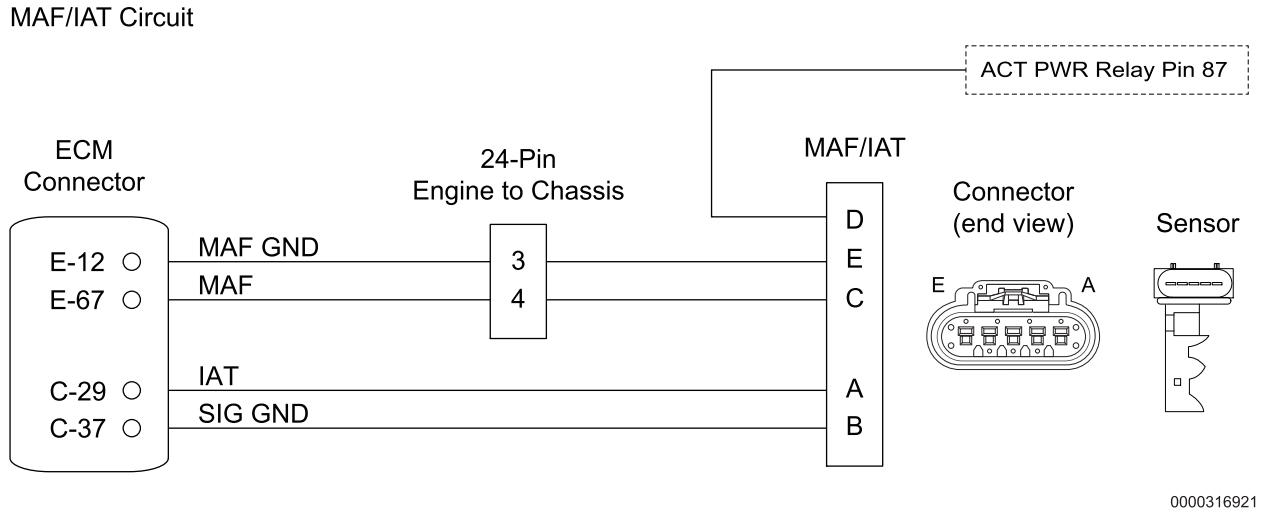
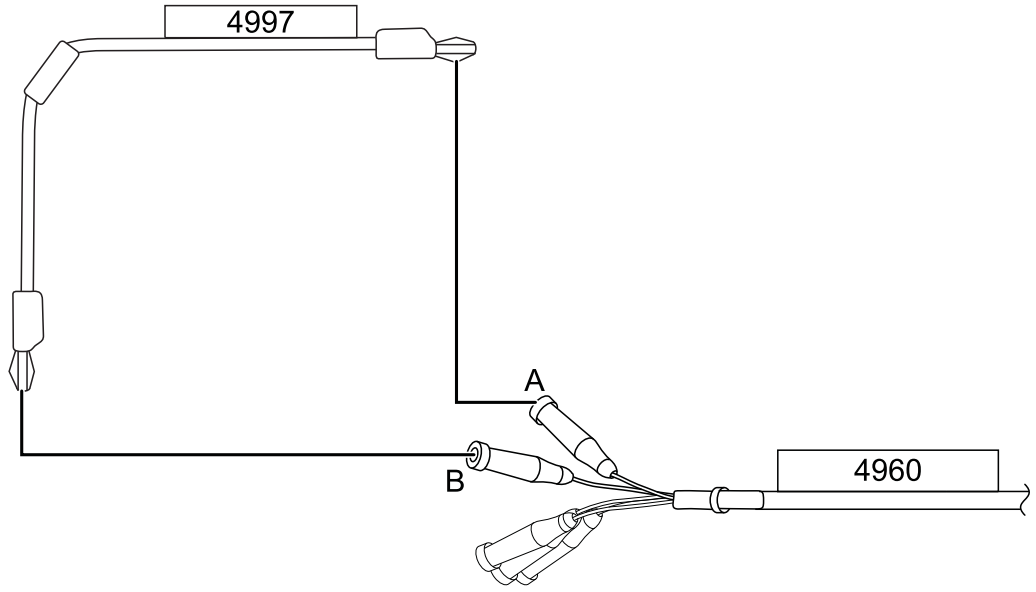


Figure 722 Intake Air Temperature (IAT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4960
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334761

Figure 723 Test 1 IAT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Intake Air Temperature (IAT) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness connector and leave IAT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4960 pin-A and pin-B. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor intake air temperature.	154 ± 10°F (67.8 ± -12.2°C)
Decision	
Is temperature 154 ± 10°F (67.8 ± -12.2°C)?	Yes: Replace IAT sensor. After repairs are complete, retest for SPN 172 FMI 2.
	No: Go to Test 2.

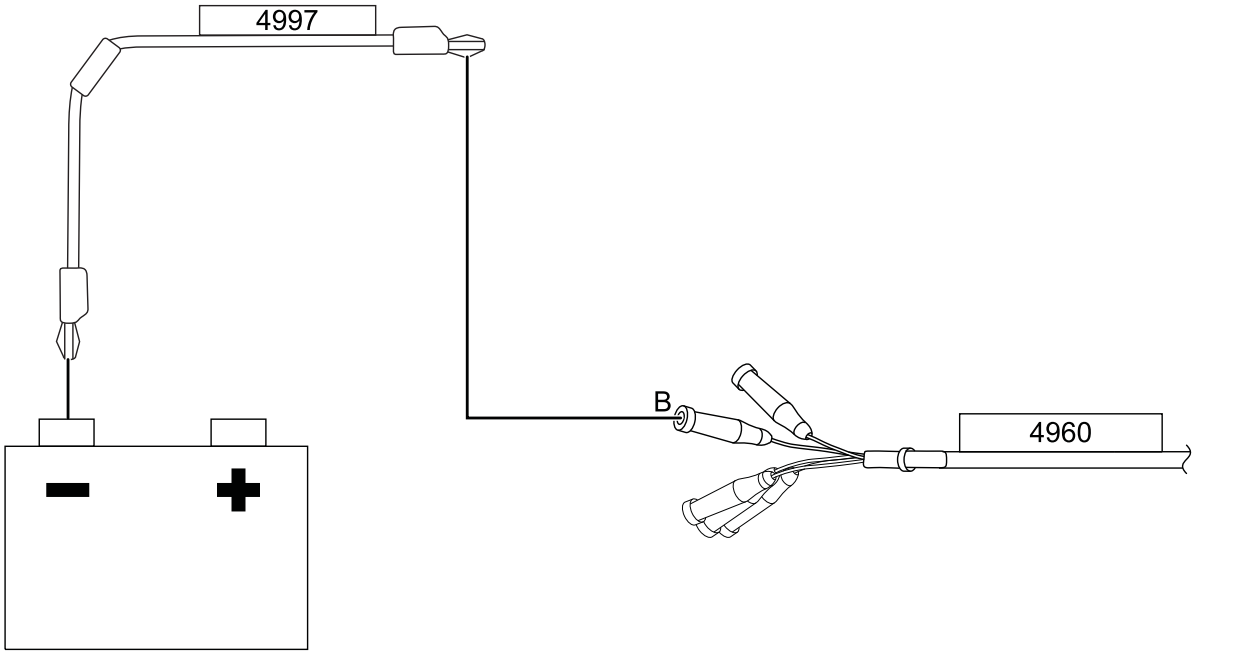


Figure 724 Test 2 IAT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Intake Air Temperature (IAT) sensor. C. Connect Breakout Harness ZTSE4960 to vehicle harness connector and leave IAT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4960 pin-B and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor intake air temperature.	154 ± 10°F (67.8 ± -12.2°C)
Decision	
Is temperature 154 ± 10°F (67.8 ± -12.2°C)?	Yes: Replace SIG GND circuit between IAT pin-A and ECM pin C-29. After repairs are complete, retest for SPN 172 FMI 2.
	No: Replace SIG circuit between EOT pin-B and ECM pin C-37. After repairs are complete, retest for SPN 172 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 172 FMI 2 fault code diagnostics.

SPN 172 FMI 3 - IAT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Temperature (IAT) sensor signal Out of Range High.	IAT sensor voltage > 4.8 Volts (< -47.2°F {-43.98°C})	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Intake Air Temperature (IAT) sensor voltage is greater than 4.8 volts for 2.5 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

None

Fault Facts

IAT sensor is located inside the Mass Air Flow (MAF) sensor assembly.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IAT circuit Open
- IAT circuit shorted to PWR
- SIG GND circuit Open
- Failed IAT sensor

Step 1	Check for active or pending fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 172 FMI 3. Is EST DTC list SPN 172 FMI 3 active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect Mass Air Flow (MAF) sensor connector for damage.	Decision
	A. Key-On Key-Off (KOEO. B. Disconnect MAF sensor connector. C. Inspect MAF connector for: damage, pinched wires, corroded terminals, loose, bent or broken pins, or broken connector housing. Is MAF connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests .
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 172 FMI 3.

Pin-Point Tests (SPN 172 FMI 3)

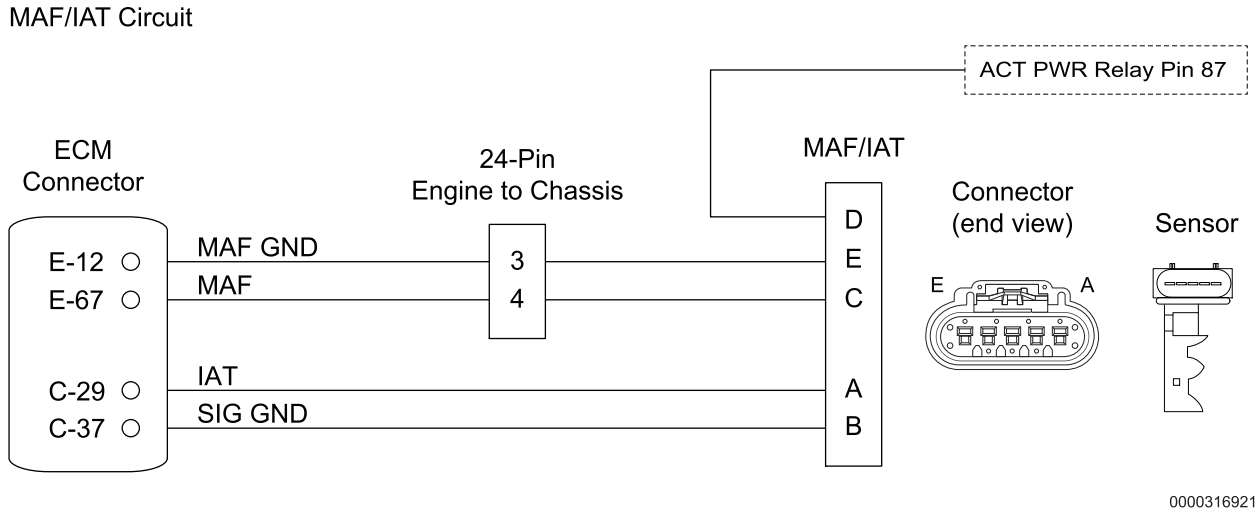


Figure 725 Mass Air Flow (MAF) / Intake Air Temperature (IAT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4498
- Breakout Harness ZTSE4960
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

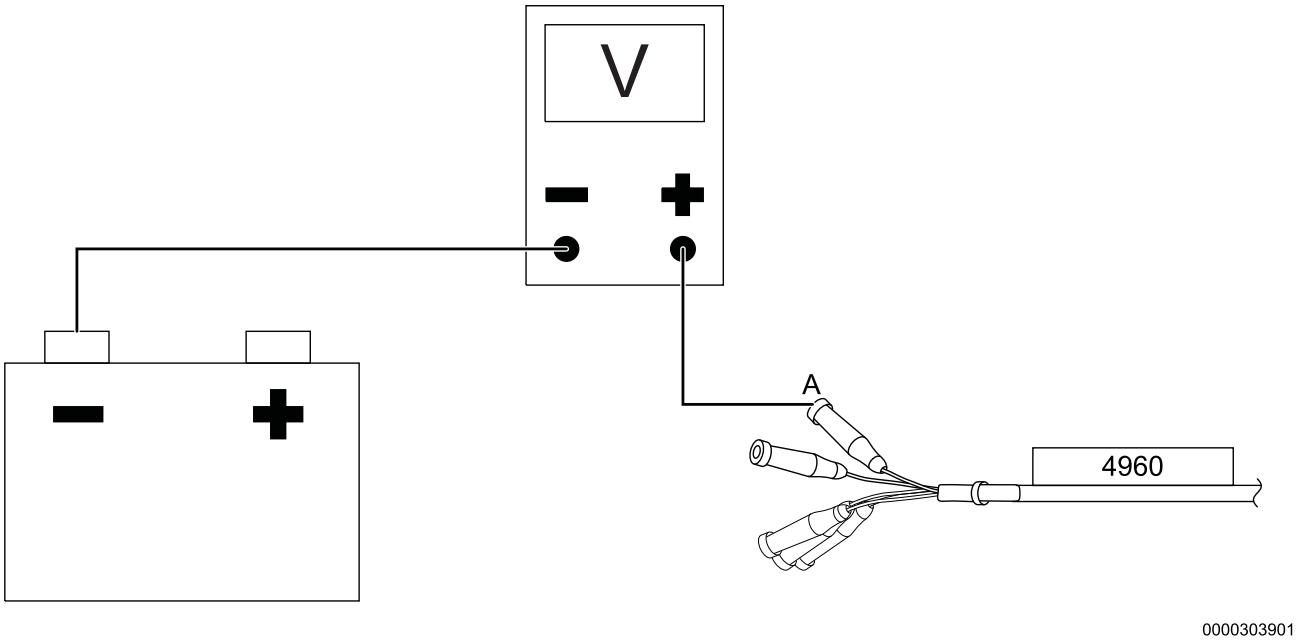
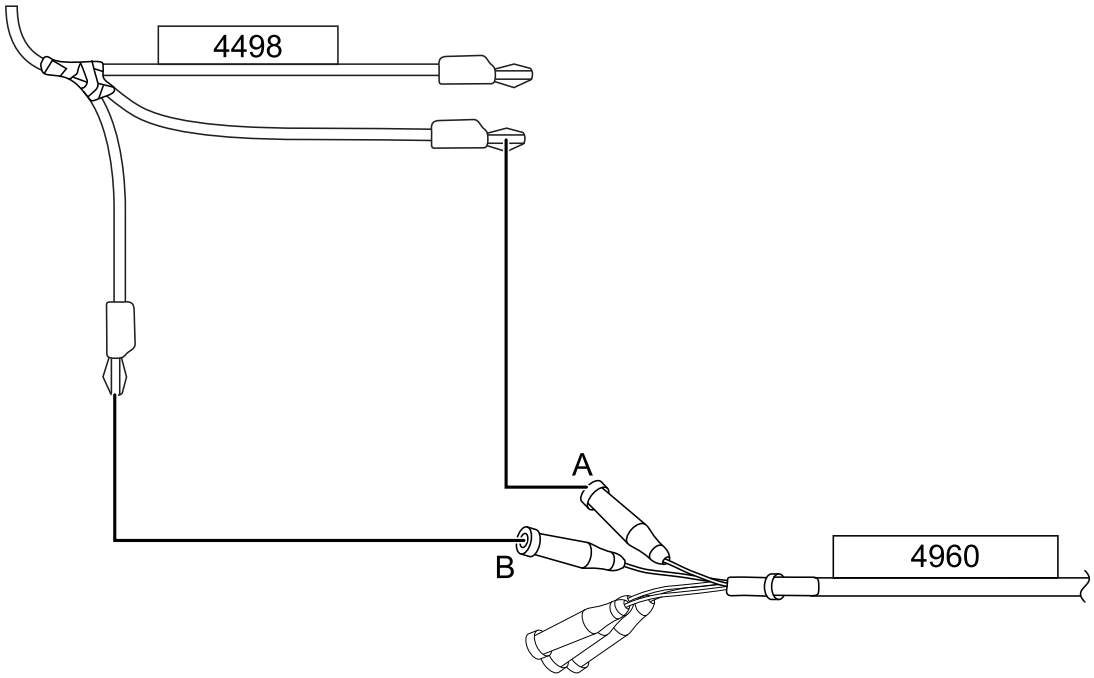


Figure 726 Test 1 Intake Air Temperature (IAT) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4960 to vehicle harness connector and leave Mass Air Flow (MAF) sensor disconnected. C. Key ON.

Test 1	Specification
Using DMM, measure voltage between Breakout Harness ZTSE4960 pin-A and known good ground.	< 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to PWR between Engine Control Module (ECM) pin C-29 and MAF pin-A. After repairs are complete, retest for SPN 172 FMI 3.
	No: Go to Test 2.



0000303903

Figure 727 Test 2 Intake Air Temperature (IAT) Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4960 to vehicle harness connector and leave Mass Air Flow (MAF) sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin A and pin B of Breakout Harness ZTSE4960 together. D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 172 FMI 4 sets after DTC list is cleared
Decision	
Does SPN 172 FMI 4 set after DTC list is cleared?	Yes: Replace MAF sensor. After repairs are complete, retest for SPN 172 FMI 3.
	No: Go to Test 3.

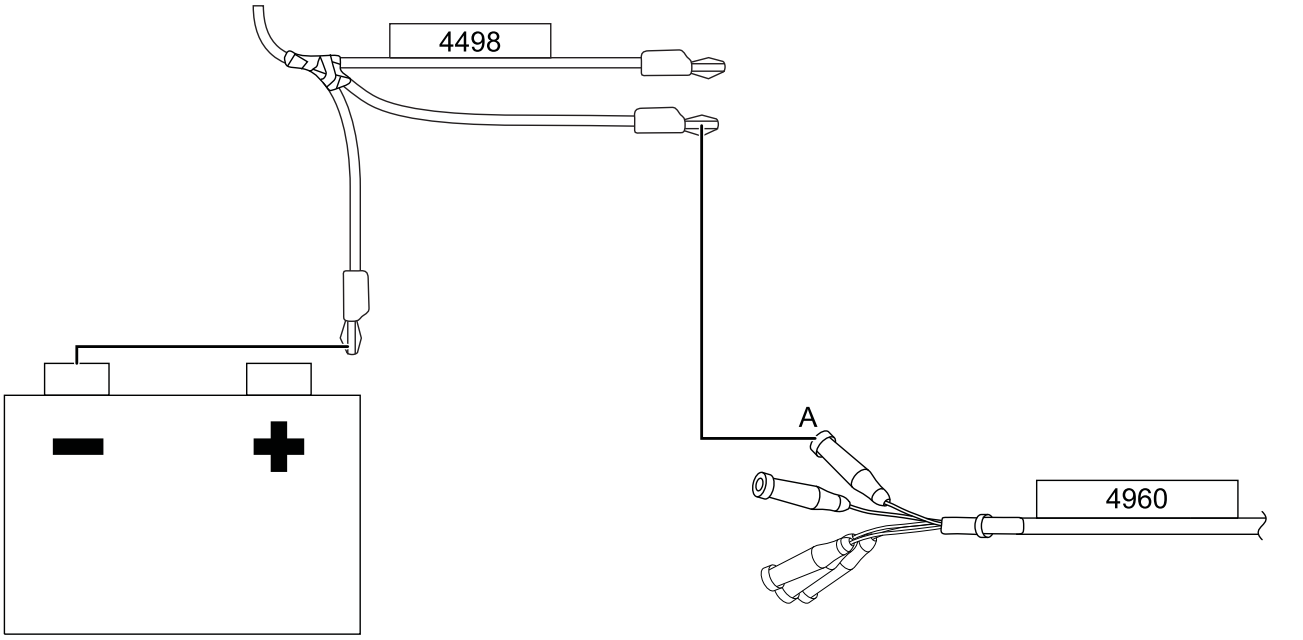


Figure 728 Test 3 Intake Air Temperature (IAT) Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4960 to vehicle harness connector and leave Mass Air Flow (MAF) sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin A of Breakout Harness ZTSE4960 to known good ground. D. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124). E. Key ON. Log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™ software, clear DTC list.	SPN 172 FMI 4 sets after DTC list is cleared
Decision	
Does SPN 172 FMI 4 set after DTC list is cleared?	Yes: Repair Open between Engine Control Module (ECM) pin C-37 and MAF pin-B. After repairs are complete, retest for SPN 172 FMI 3.
	No: Repair Open between ECM pin C-29 and MAF pin-A. After repairs are complete, retest for SPN 172 FMI 3.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 172 FMI 3 fault code diagnostics.

SPN 172 FMI 4 - IAT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Intake Air Temperature (IAT) voltage signal Out of Range Low.	IAT sensor voltage < 0.12 Volts (> 273.6°F [134.2°C])	Key ON

Fault Overview

Fault code sets when Electronic Control Module detects Intake Air Temperature (IAT) senosr voltage signal is less than expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

None

Fault Facts

IAT sensor is located inside the Mass Air Flow (MAF) sensor assembly.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- IAT circuit short to ground
- Failed MAF sensor

Step 1	Check for active or pending fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 172 FMI 4. Is EST DTC list SPN 172 FMI 4 active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Mass Air Flow (MAF) sensor.	Decision
	A. Key OFF. B. Disconnect MAF sensor connector. C. Inspect MAF connector for: damage, pinched wires, corroded terminals, loose, bent or broken pins, or broken, connector housing. Is MAF connector, harness, and terminals clean and undamaged?	Yes: Go to Pin-Point Tests .
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 172 FMI 4.

Pin-Point Tests (SPN 172 FMI 4)

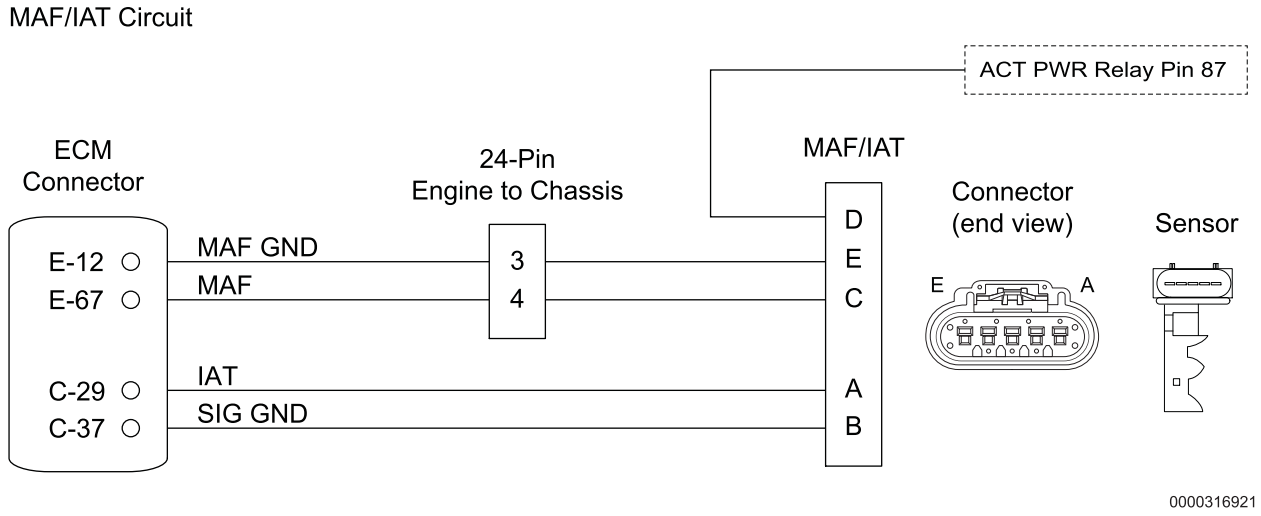


Figure 729 Mass Air Flow (MAF) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Mass Air Flow (MAF) sensor. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, clear Diagnostic Trouble Code (DTC) list.	SPN 172 FMI 3 sets after DTC list is cleared
Decision	
Does SPN 172 FMI 3 set after DTC list is cleared?	Yes: Replace MAF sensor. After repairs are complete, retest for SPN 172 FMI 4.
	No: Repair short to ground between MAF pin-A and Engine Control Module (ECM) Pin C-29. After repairs are complete, retest for SPN 172 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 172 FMI 4 fault code diagnostics.

NOx (Nitrogen Oxides) Sensor Module

Overview of NOx Sensor Group

SPN	FMI	Description
3216	4	NOxIN signal Out of Range LOW (page 1830)
3216	10	NOxIN signal abnormal rate of change (page 1832)
3216	13	NOxIN Out of Calibration (page 1834)
3216	19	NOxIN not detected on J1939 (page 1837)
3216	20	NOxIN signal drifted HIGH (page 1849)
3216	21	NOxIN signal drifted LOW (page 1851)
3218	2	NOxIN power supply signal erratic, intermittent or incorrect (page 1853)
3226	2	NOxOUT signal erratic, intermittent or incorrect (page 1859)
3226	4	NOxOUT signal Out of Range LOW (page 1866)
3226	10	NOxOUT signal abnormal rate of change (page 1868)
3226	13	NOxOUT Out of Calibration (page 1870)
3226	19	NOxOUT not detected on J1939 (page 1872)
3226	20	NOxOUT signal drifted HIGH (page 1882)
3226	21	NOxOUT signal drifted LOW (page 1884)
3228	2	NOxOUT power supply signal erratic, intermittent or incorrect (page 1886)
5024	10	NOxIN Sensor Heater abnormal rate of change (page 1893)
5031	10	NOxOUT Sensor Heater not reading correctly (page 1898)

Overview

Nitrogen Oxides Intake Concentration (NOx In) and Nitrogen Oxides Outlet Concentration (NOx Out) sensors are smart device used to measure NOx emissions at intake of aftertreatment system and measure the NOx emissions at outlet of Selective Catalyst Reduction (SCR) Catalyst. NOx In and NOx Out sensors perform internal diagnostics and reports malfunctions back to ACM using J1939 data link. NOx In and NOx Out sensors are permanently attached to NOx control module. They are serviced as a single component and can not be replaced individually.

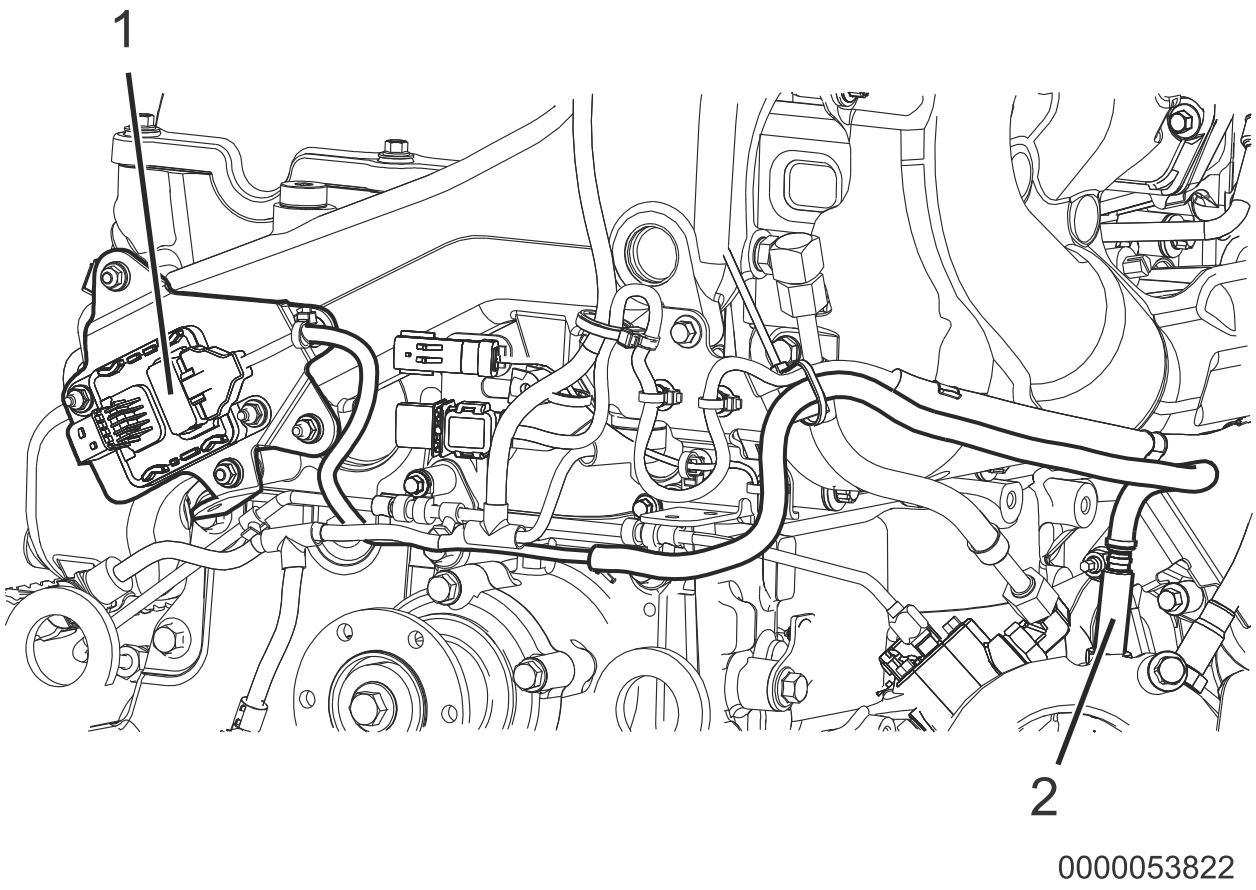


Figure 730 Nitrogen Oxides Intake Concentration (NOx In) Sensor Location

1. NOx In module
2. NOx In sensor

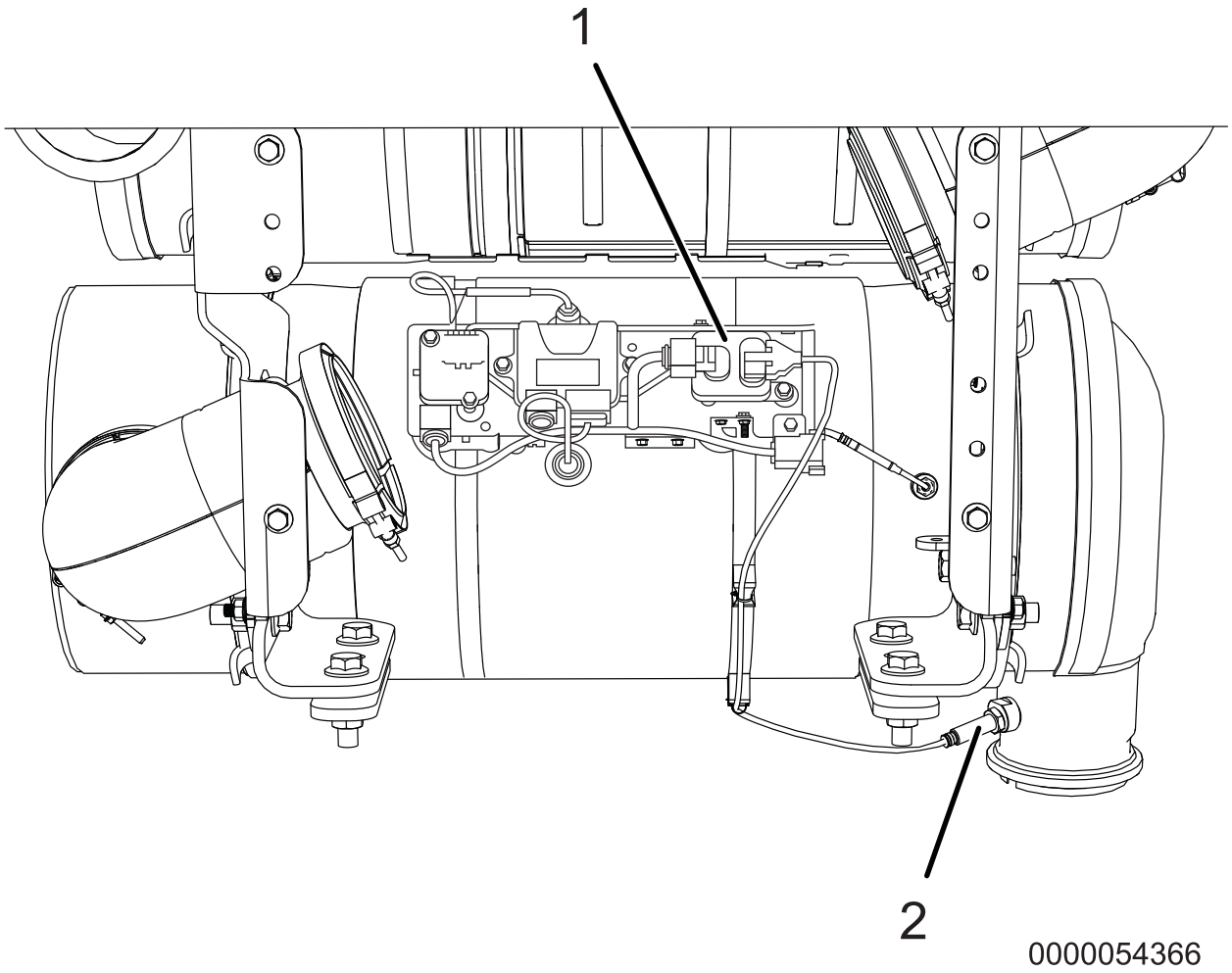


Figure 731 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Location

1. NOx Out module
2. NOx Out sensor

SPN 3216 FMI 4 - NOxIN signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Nitrogen Oxides Intake Concentration (NOx In) sensor voltage below normal or shorted to low source.	Percentage of time spent in heating mode, as opposed to automatic mode, is > 5 % or number of transitions from automatic mode to one of the heating states is > 5 Counts	Time after sensor has reached working temperature and has entered automatic mode > 30 seconds Exhaust gas velocity < 60 m/sec Diesel Oxidation Catalyst Intake Temperature (DOCIT) < 1472°F (800°C) Exhaust Gas Temperature (EGT) is above threshold representing point there is no longer a concern of condensation on NOx In sensor element. NOx In sensor battery supply voltage is ≥ 11.4 volts and ≤ 16.5 volts for more than 0.2 seconds. Inactive: SPN 3216 FMI 19 and SPN 3218 FMI 2.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects an internal circuit error in Nitrogen Oxides Intake Concentration (NOx In) sensor. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled, and engine torque is severely reduced.

Lamp Reaction

Malfunction indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3218 FMI 2 (NOxIN)	• SPN 3216 FMI 19 (NOxIN)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx In sensor

Step 1	Check for associated fault codes.	Decision
	Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1830). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3216 FMI 4.

Step 2	Check for active or pending fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3216 FMI 4. Is EST DTC list SPN 3216 FMI 4 active or pending?	Yes: Go to Step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor connector. C. Check NOx In sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor, connector, harness, and terminals clean and undamaged?	Yes: Replace NOx In sensor. After repairs are complete, retest for SPN 3216 FMI 4.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3216 FMI 4.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3216 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3216 FMI 10 - NOxIN signal abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Intake Concentration (NOx In) sensor reading is not valid.	Percent of time > 50% when NOx In sensor reading is not valid (NOx fault).	Exhaust pipe status pressure must be data-valid. Exhaust pressure change rate < 0 kPa/s. Exhaust pipe status mass flow rate must be data-valid. Exhaust mass flow change rate < 0 (g/s^2). Inactive: SPN 3216 FMI 4 and 19 (NOx In); SPN 3218 FMI 2 (NOx In).

Fault Overview

Fault code sets when Nitrogen Oxides Intake Concentration (NOx In) sensor reading is invalid.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3216 FMI 4 and 19 (NOx In)	• SPN 3218 FMI 2 (NOx In)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx In sensor

Step 1	Check for associated faults.	Decision
	Using EST with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1832). Is DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3216 FMI 10.

Step 2	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3216 FMI 10. Is EST DTC list SPN 3216 FMI 10 active or pending?	Yes: Go to Step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Sensor and connector inspection.	Decision
	A. Key OFF. B. Disconnect Nitrogen Oxides Intake Concentration (NOx In) sensor. C. Check NOx In sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor connector, harness, and terminals clean and undamaged?	Yes: Replace NOx In sensor. After repairs are complete, retest for SPN 3216 FMI 10.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3216 FMI 10.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3216 FMI 10 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3216 FMI 13 - NOx IN Out of Calibration

Condition / Description	Setting Criteria	Enable Conditions / Values
Calibration mismatch between Nitrogen Oxide In (NOx In) sensor and Aftertreatment Control Module (ACM).	Rated NOx In sensor voltage does not match nominal system voltage of 0 volts.	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects a mismatch between engine's electrical system voltage and Nitrogen Oxide In (NOx In) sensor voltage rating.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle

Continuous

Possible Causes

- Incorrect NOx In sensor

Step 1	Check for active or pending fault code	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 3216 FMI 13. Is EST DTC list SPN 3216 FMI 13 active or pending?	Yes: Replace Nitrogen Oxide In (NOx In) sensor. After repairs are complete, retest for SPN 3216 FMI 13.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3216 FMI 13 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3216 FMI 19 - NOx IN not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Values
Loss of communication or invalid data from Nitrogen Oxides Intake Concentration (NOx In) sensor.	Aftertreatment Control Module (ACM) loses J1939 data link communications with NOx In sensor	Key ON Engine not cranking **NOTE:** Data link-related faults are inhibited for calibration adjustable amount of time following a Key ON event, low battery voltage event, engine cranking event, and stop / suspend broadcast event. This is to allow reasonable time for data link devices to power up and begin periodic broadcasts before Engine Control Module (ECM) performs time-out diagnostics

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) loses J1939 data link communications with Nitrogen Oxides Intake Concentration (NOx In) sensor. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled and engine torque will be severely reduced.

Lamp Reaction

When fault is active, Malfunction Indicator Lamp (MIL)will not illuminate.

Associated Faults

SPN's 3216 FMI 2, 20, and 21			

Fault Facts

If more than one of the following sensor modules fail (or set a fault), suspect common power circuit, ground circuit, or switched ignition relay problem. Following components share power and ground circuits:

- Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module
- Selective Catalyst Reduction (SCR) sensor module
- Aftertreatment Ammonia (NH3) sensor module
- Nitrogen Oxides Outlet Concentration (NOx Out) sensor
- Nitrogen Oxides Intake Concentration (NOx In) sensor
- Diesel Exhaust Fluid Tank Level and Temperature (DEF: TL and DEF: TT) sensor

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SWBAT circuit Open or short to GND
- CAN-AH circuit Open or short to GND

- CAN-AL circuit Open or short to GND
- CAN-AH circuit short to PWR
- CAN-AL circuit short to PWR
- GND circuit Open or high resistance
- CAN-AH short to CAN-AL
- Failed NOx In sensor

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1837). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

Step 2	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor module connector. C. Check NOx In sensor module and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor module, connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

Pin-Point Tests (SPN 3216 FMI 19)

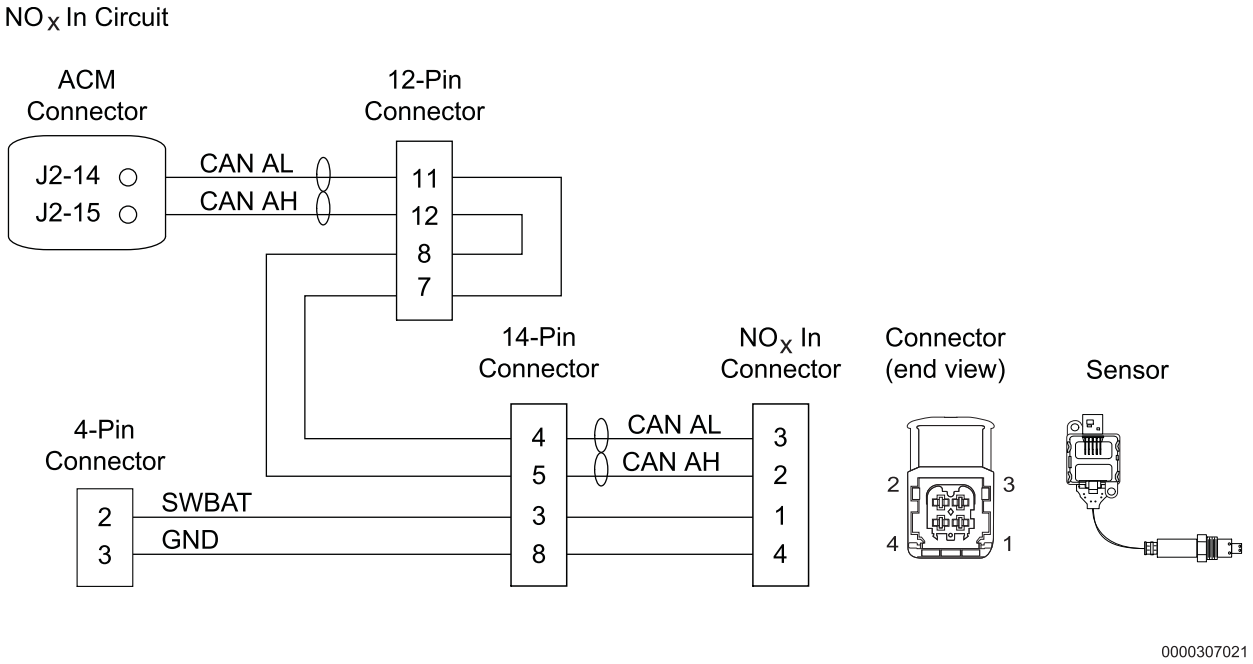
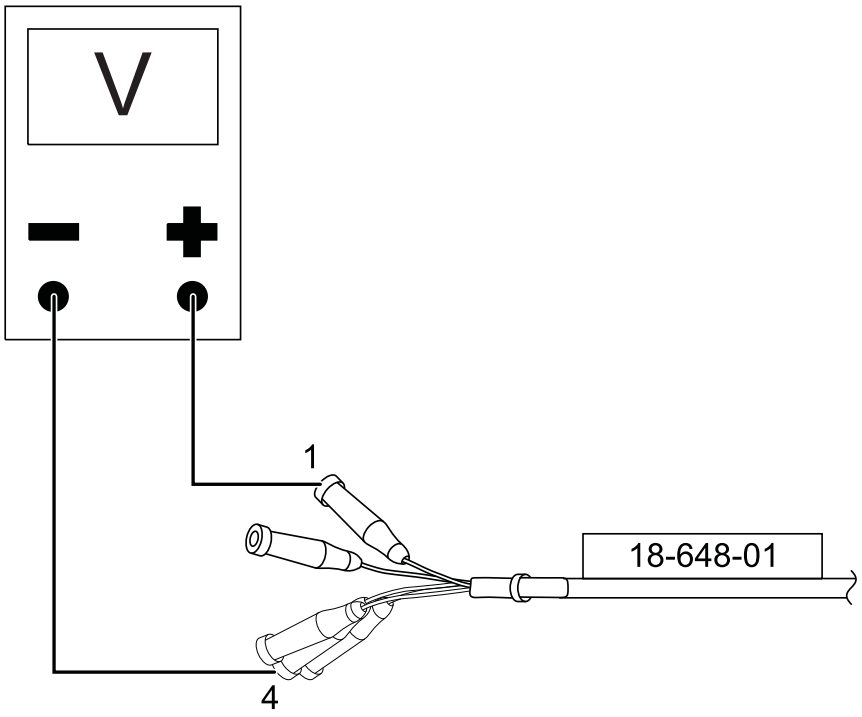


Figure 732 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)



0000308508

Figure 733 Test 1 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Verify batteries are fully charged and connections are clean. C. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. D. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 2.

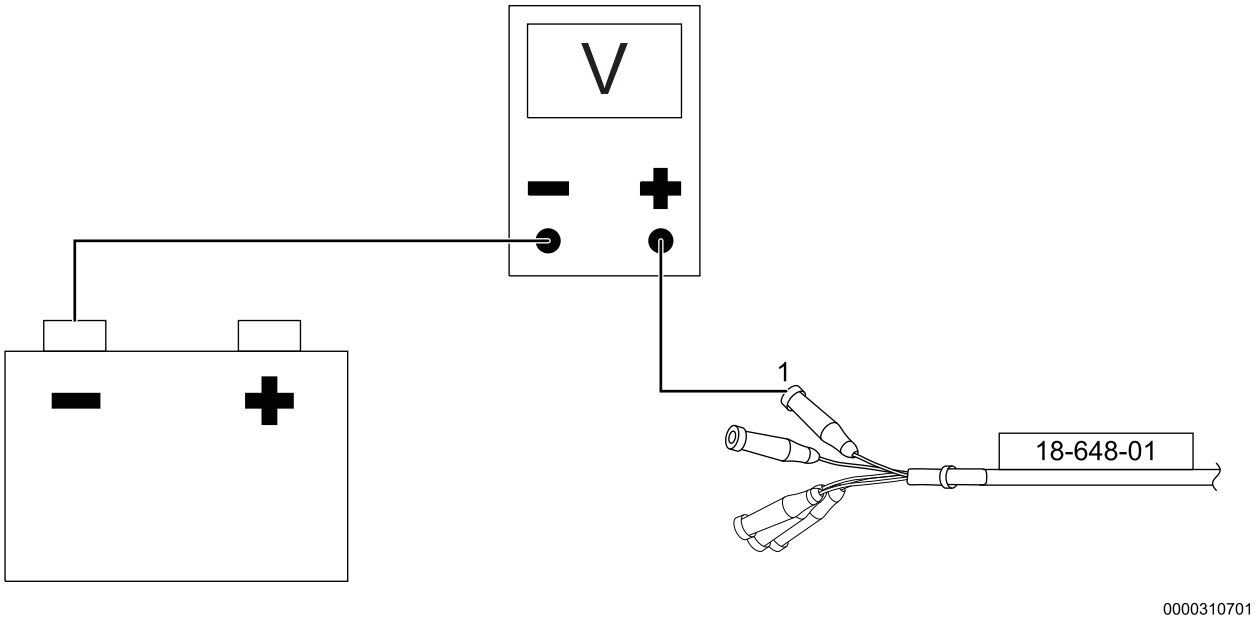


Figure 734 Test 2 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 2	Specification
Use DMM to measure voltage between NOx In sensor pin-1 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage at pin-1 B+ ± 0.5 volt?	Yes: Repair Open or high resistance between NOx In sensor pin-4 and GND. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.
	No: Repair Open or short to GND between NOx In sensor connector pin-1 and switched ignition relay pin-87. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

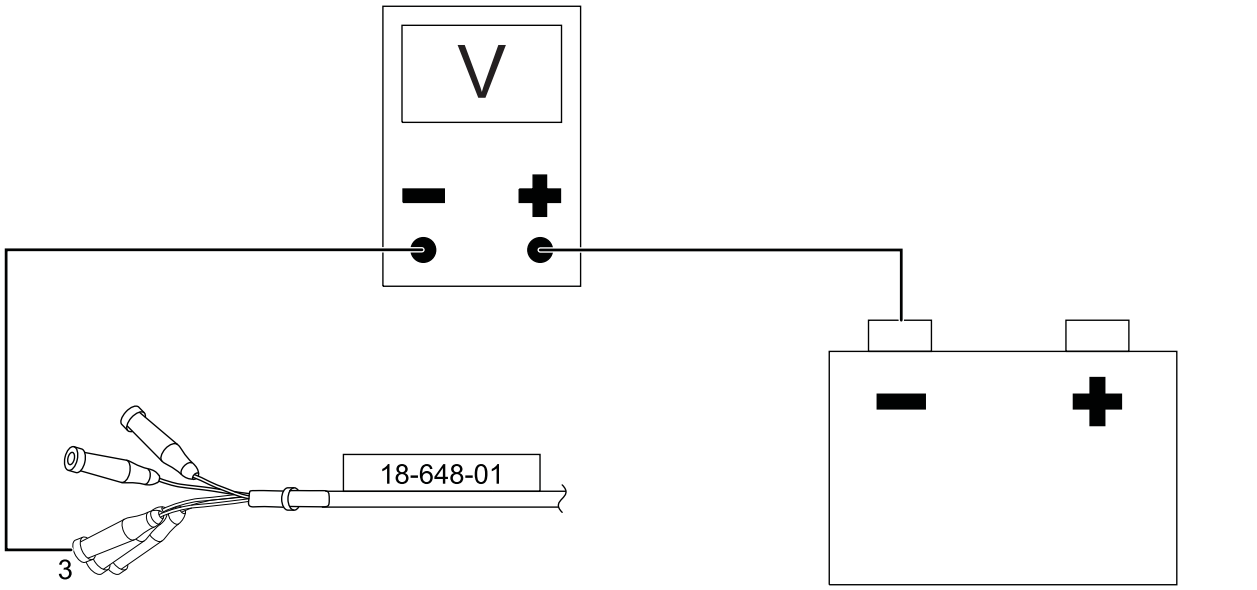


Figure 735 Test 3 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 3	Specification
Use DMM to measure voltage between NOx In sensor pin-3 and known good GND.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 4.
	No: Repair Open or short to GND between NOx In sensor connector pin-3 and ACM connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

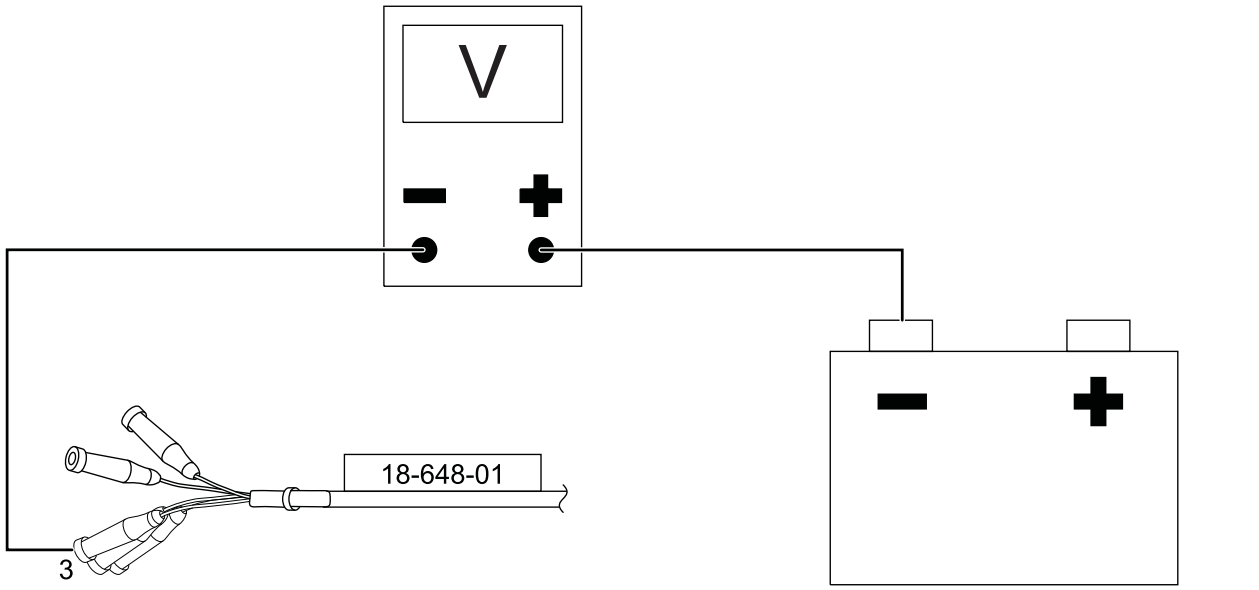


Figure 736 Test 4 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 4	Specification
Use DMM to measure voltage between temperature sensor pin-3 and known good GND.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 5.
	No: Repair short to PWR between NOx In sensor connector pin-3 and ACM connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

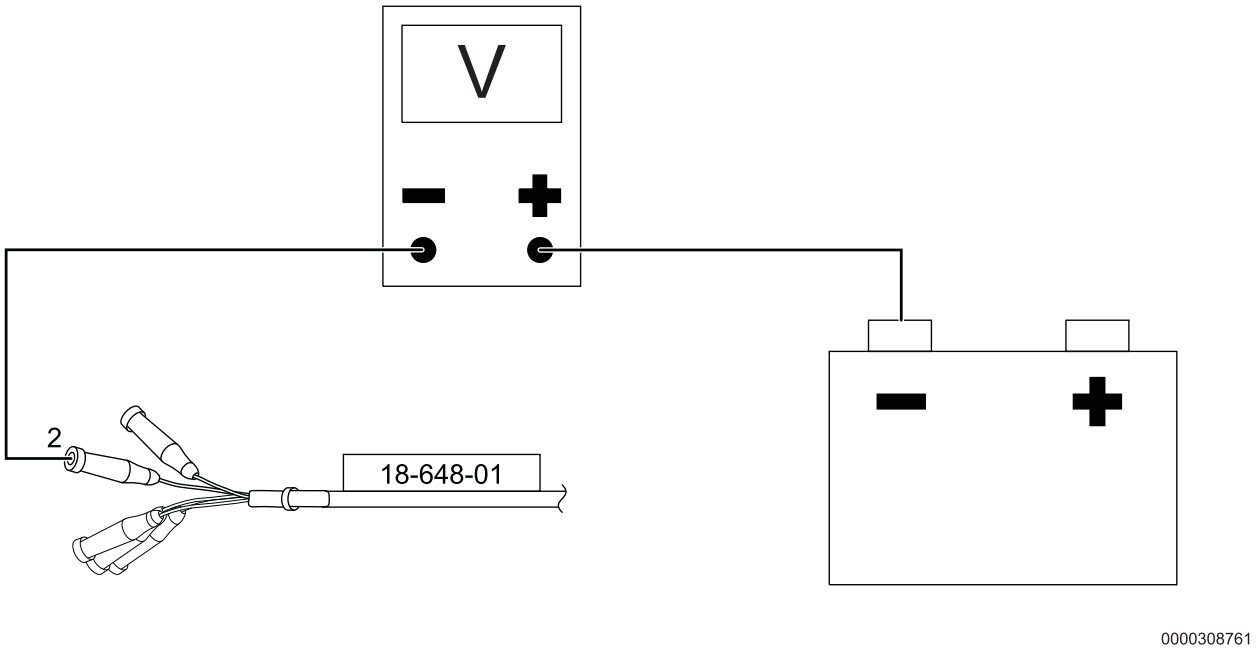


Figure 737 Test 5 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 5	Specification
Use DMM to measure voltage between temperature sensor pin-2 and known good GND.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 6.
	No: Repair Open or short to GND between NOx In sensor connector pin-2 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

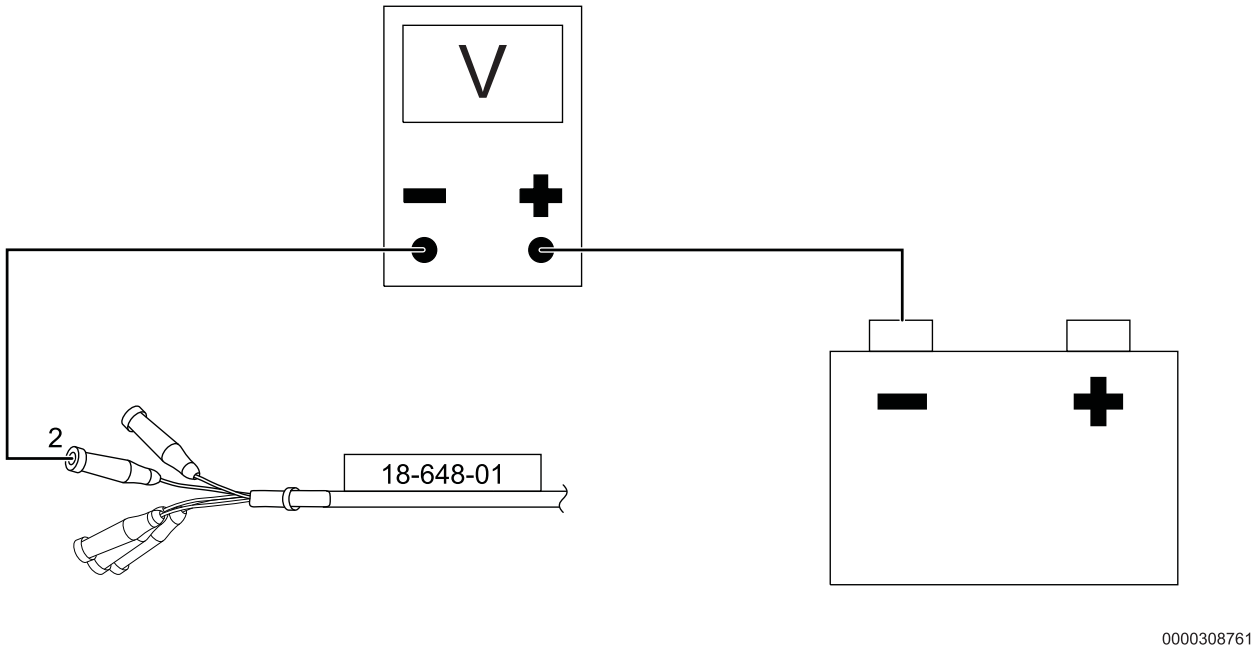
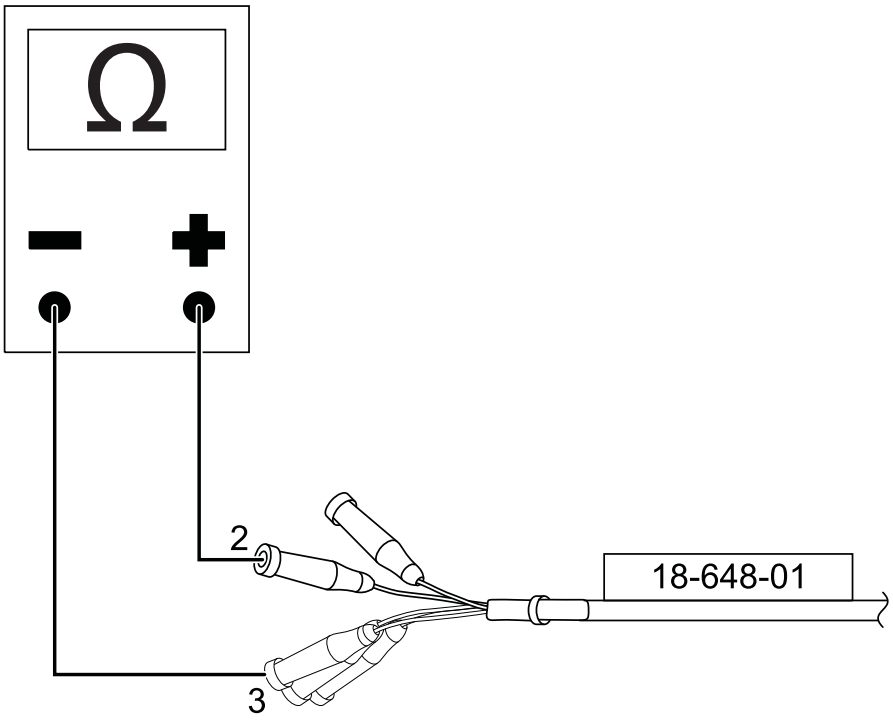


Figure 738 Test 6 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 6	Specification
Use DMM to measure voltage between temperature sensor pin-2 and known good GND.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 7.
	No: Repair short to PWR between NOx In sensor connector pin-2 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.



0000308762

Figure 739 Test 7 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector and vehicle harness. C. Key-On Engine-Off (KOEO).

Test 7	Specification
Use DMM to measure resistance between temperature sensor pin-2 and pin-3.	Greater than 50 ohms
Decision	
Is resistance greater than 50 ohms?	Yes: Replace NOx In sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.
	No: Repair short between NOx In sensor connector pin-2 and pin-3. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3216 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and proper decision was made. Return to SPN 3216 FMI 19 fault code diagnostics.

SPN 3216 FMI 20 - NOxIN signal drifted HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Intake Concentration (NOx In) sensor signal drifted HIGH.	When idle conditions are detected, compare NOx (ppm) from NOx In sensor to NOx In model (> 2500 ppm and < 3500 ppm)	Engine speed < 3000 rpm Key ON Battery voltage > 10.7 volts Battery voltage < 15 volts Ambient Temp > -40°F (-40°C) and < 302°F (150°C) Ambient Pressure between 0 psi (0 kPa) and 87 psi (600 kPa) Engine Coolant Temperature > -40°F (-40°C) and < 302°F (150°C)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines signal from Nitrogen Oxides Intake Concentration (NOx In) sensor is high compared to its modeled value for conditions. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled and engine torque will be severely reduced. Vehicle speed will be limited if code is active for an extended period of time.

Lamp Reaction

When fault is active, Malfunction Indicator Lamp (MIL) will not illuminate.

Associated Faults

• SPN 3216 FMI 4 and 19 (NOx)	• SPN 3218 FMI 2 (NOx)		

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

None

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1849). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 3216 FMI 20.

Step 2	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor connector. C. Check NOxIn sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor, connector, harness, and terminals clean and undamaged?	Yes: Replace NOx In sensor. After repairs are complete, retest for SPN 3216 FMI 20. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3216 FMI 20.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3216 FMI 20 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3216 FMI 21 - NOxIN signal drifted LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Control Module (ACM) determines Nitrogen Oxides Intake Concentration (NOx In) sensor signal drifted LOW.	When steady-state conditions are detected, compare NOx (ppm) from NOx sensor to NOx model (> -500 ppm and < -50 ppm).	Key ON Engine speed < 3000 rpm Ambient Temp between -40°F (-40°C) and 302°F (150°C) Ambient Pressure between 0 psi (0 kPa) and 87 psi (600 kPa) Engine Coolant Temperature between -40°F (-40°C) and 302°F (150°C)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines signal from Nitrogen Oxides Intake Concentration (NOx In) sensor is low compared to it's modeled value for conditions. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled, and engine torque will be severely reduced. Vehicle speed will be limited if code is active for an extended period of time.

Lamp Reaction

When fault is active, Malfunction Indicator Lamp (MIL) will not illuminate.

Associated Faults

• SPN 3216 FMI 4 and 19 (NOx)	• SPN 3218 FMI 2 (NOx)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx In sensor

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1851). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for 3216 FMI 21.

Step 2	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor connector. C. Check NOx In sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor, connector, harness, and terminals clean and undamaged?	Yes: Replace NOx In sensor. After repairs are complete, retest for SPN 3216 FMI 21.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3216 FMI 21.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3216 FMI 21 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3218 FMI 2 - NOxIN power supply signal erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Intake Concentration (NOx In) sensor circuitry has detected battery supply voltage is outside desired range.	NOx In sensor supply voltage > 16.5 volts for 10 seconds NOx In sensor supply voltage < 11.4 volts for 10 seconds	160 seconds after exhaust gas temperature is above threshold representing point there is no condensation on NOx In sensor element. 100 seconds after NOx sensor has reached its operating temperature. SPN 3216 FMI 9 inactive

Fault Overview

Fault code sets when Engine Control Module (ECM) detects power supply to Nitrogen Oxides Intake Concentration (NOx In) sensor is above or below calibration adjustable threshold.

Lamp Reaction

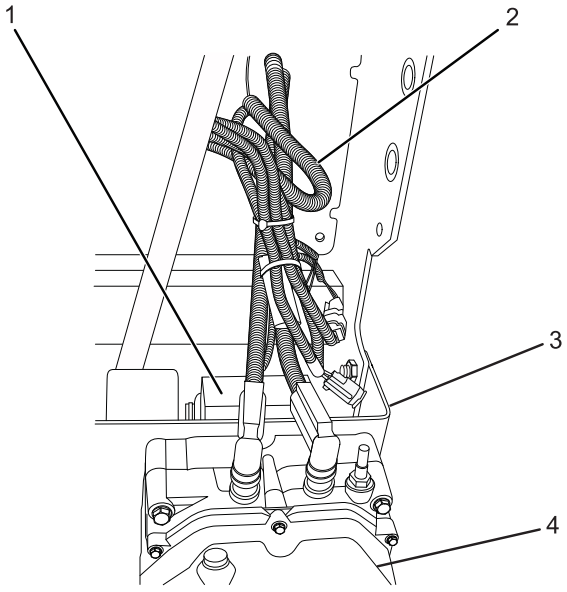
Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Drive Cycle to Determine Fault Status

Continuous



0000041928

Figure 740 PDM Location (typical)

1. Power Distribution Module (PDM)
2. Diesel Exhaust Fluid (DEF) tank assembly
3. DEF supply module bracket
4. DEF supply module

Step 1	Inspect fuse(s), relay(s), and connections at Power Distribution Module (PDM).	Decision
	A. Key OFF. B. Disconnect Nitrogen Oxides Intake Concentration (NOx In) sensor connector. C. Check PDM fuse(s) and relay(s) for blown fuses; loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?	Yes: Go to step 2. No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 3218 FMI 2.

Step 2	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor connector. C. Check NOx In sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor, connector, harness, and terminals clean and undamaged?	Yes: Go to step 3. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3218 FMI 2.

Step 3	Inspect battery voltage / connections.	Decision
	A. Key OFF. B. Check for low battery voltage. C. Inspect battery connections and terminals. Are connections tight and corrosion free, and is battery voltage at least 10 volts?	Yes: Perform Pin-Point Tests. No: Clean battery terminals, tighten loose connections, and charge batteries as needed. After repairs are complete, retest for SPN 3218 FMI 2.

Pin-Point Tests (SPN 3218 FMI 2)

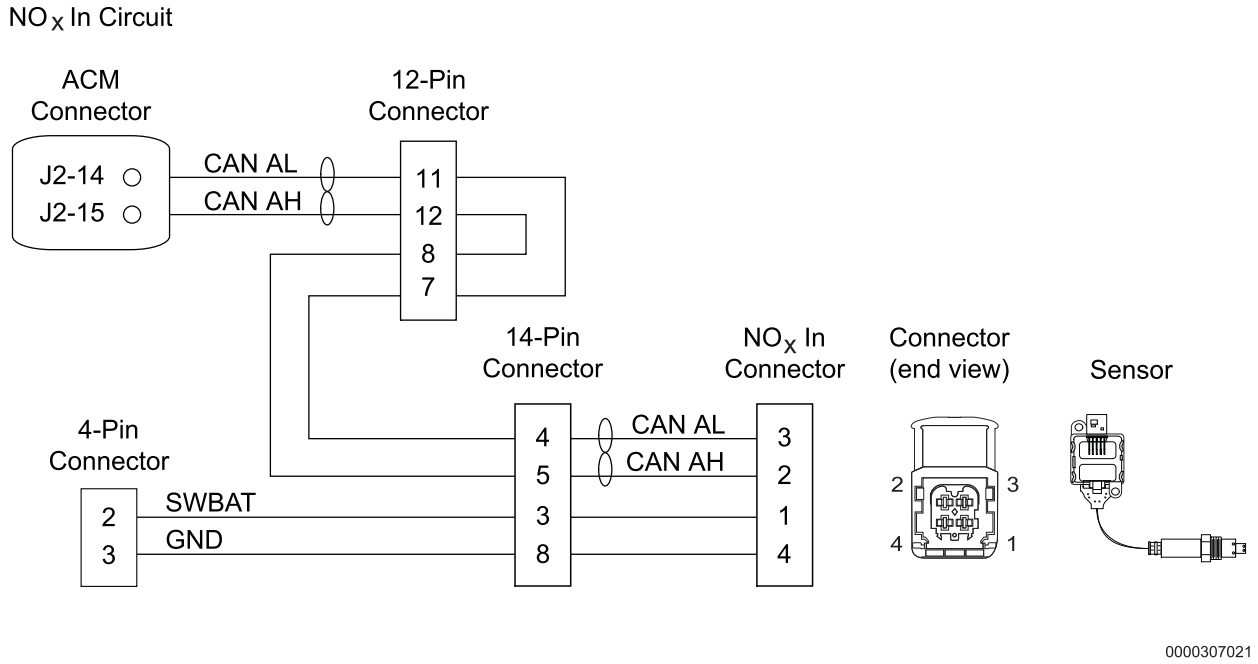
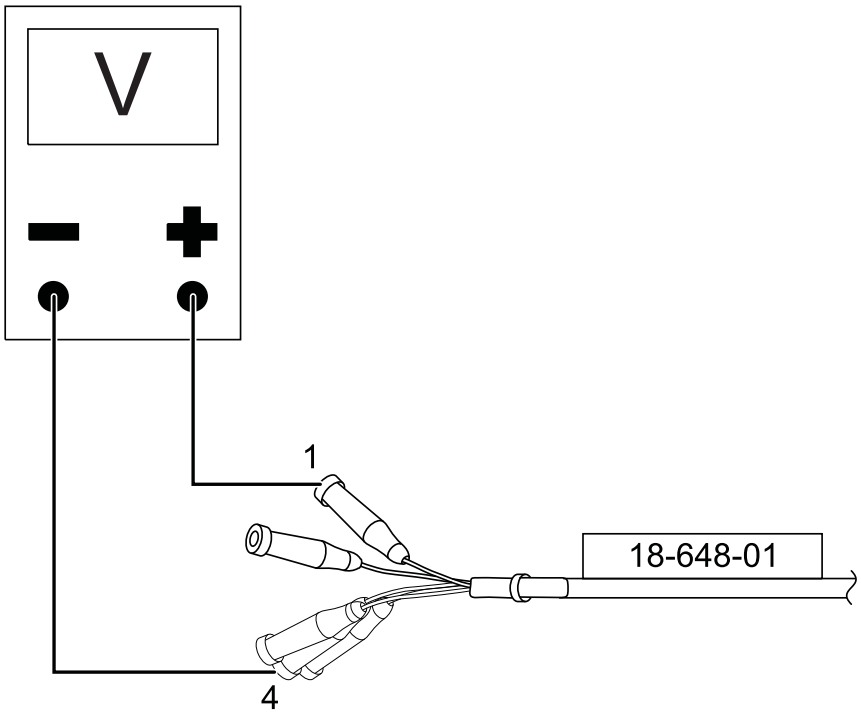


Figure 741 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)



0000308508

Figure 742 Test 1 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between NOx In sensor connector pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 2.

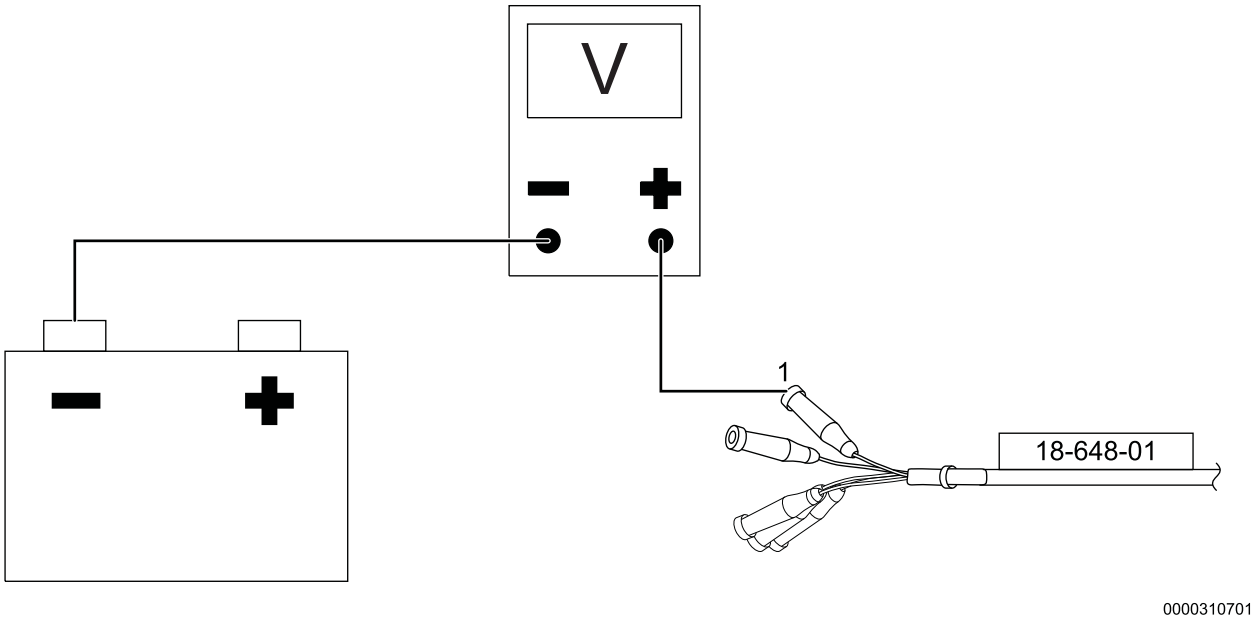


Figure 743 Test 2 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor harness connector. C. Key-On Engine-Off (KOEO).

Test 2	Specification
Use DMM to measure voltage between NOx In sensor connector pin-1 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage at pin-1 B+ ± 0.5 volts?	Yes: Repair Open or high resistance between NOx In sensor connector pin 4 and GND. After repairs are complete, retest for SPN 3218 FMI 2.
	No: Repair Open or short to GND between NOx In sensor connector pin-1 and switched ignition relay pin-87. After repairs are complete, retest for SPN 3218 FMI 2.

Test 3 Setup
A. Key OFF.

Test 3	Specification
Check for incorrect Nitrogen Oxides Intake Concentration (NOx In) sensor installed.	
Decision	
Is correct NOx In sensor installed?	Yes: Replace NOx In sensor. After repairs are complete, retest for SPN 3218 FMI 2.
	No: Install correct NOx In sensor. After repairs are complete, retest for SPN 3218 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3218 FMI 2 fault code diagnostics.

SPN 3226 FMI 2 - NOx OUT Signal Erratic, Intermittent, or Incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Control Module (ACM) has detected that Nitrogen Oxide Out (NOx Out) sensor output is in range, but not varying as expected.	Difference between the maximum and minimum NOx Out sensor output < 10 ppm during 3 valid monitoring events	Selective Catalytic Reduction (SCR) intake NOx flow rate> 0.2 g/sec Rate of change of SCR intake NOx flow rate > 0.1 g/sec Exhaust mass flow rate > 150 g/sec NOx Out sensor reading is valid, no active faults detected by sensor, sensor's battery supply voltage is within desired range, and dew point temperature has been met for sufficient time to allow sensor to light off. None of the Abort Conditions are satisfied Inactive: SPN 3226 FMI 4, 10, and 13; SPN 3228 FMI 2; SPN 3242 FMI 2, 3, and 4; SPN 4765 FMI 2, 3, and 4; SPN 5031 FMI 10; SPN 5742 FMI 3, 4, 11, and 12.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Nitrogen Oxides Outlet Concentration (NOx Out) sensor module is not reading zero, or is not changing with engine conditions.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 FMI 4 (NOx Out)	• SPN 3228 FMI 2 (NOx Out)	• SPN 5031 FMI 10 (NOx Out)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Open or high resistance in the GND circuit
- Open or short to ground in the SWBAT circuit
- Failed NOx Out sensor module

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1859). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3226 FMI 2.

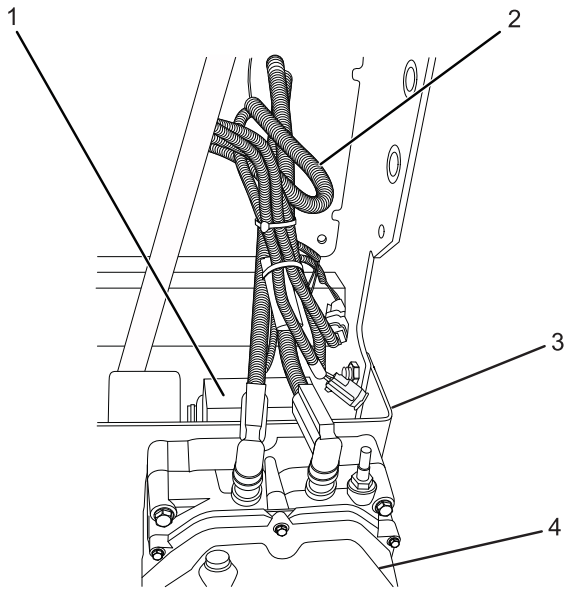


Figure 744 Power Distribution Module (PDM) Location (typical)

1. PDM
2. Diesel Exhaust Fluid (DEF) tank assembly
3. DEF supply module bracket
4. DEF supply module

Step 2	Inspect Power Distribution Module (PDM) fuse(s) and relay(s).	Decision
	Check PDM fuse(s) and relay(s) for blown fuses; loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?	Yes: Go to Step 3.
		No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 3226 FMI 2.

Step 3	Inspect connections at Nitrogen Oxides Outlet Concentration (NOx Out) sensor module.	Decision
	A. Key OFF. B. Disconnect NOx Out sensor module. C. Check NOx Out sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx Out sensor module connector, harness, and terminals clean and undamaged?	Yes: Go to Pin-Point Diagnostics. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3226 FMI 2.

Pin-Point Tests SPN 3226 FMI 2

NO_X Out Circuit

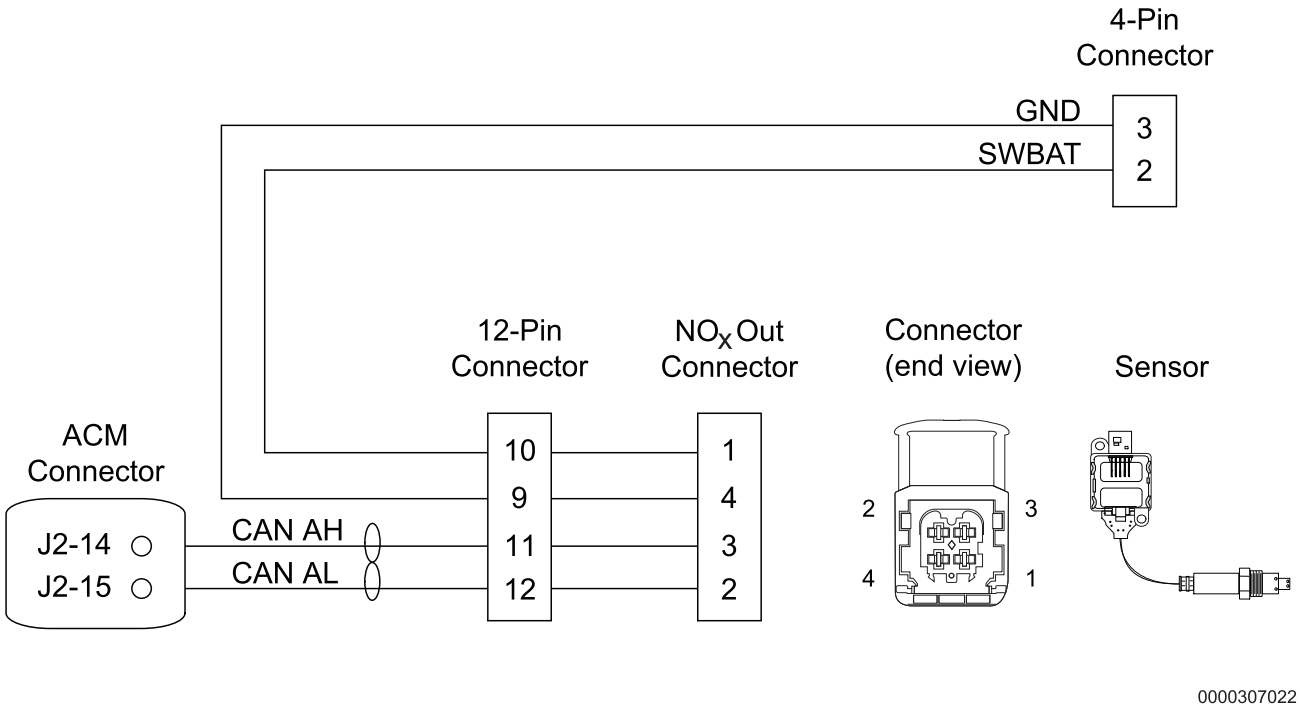
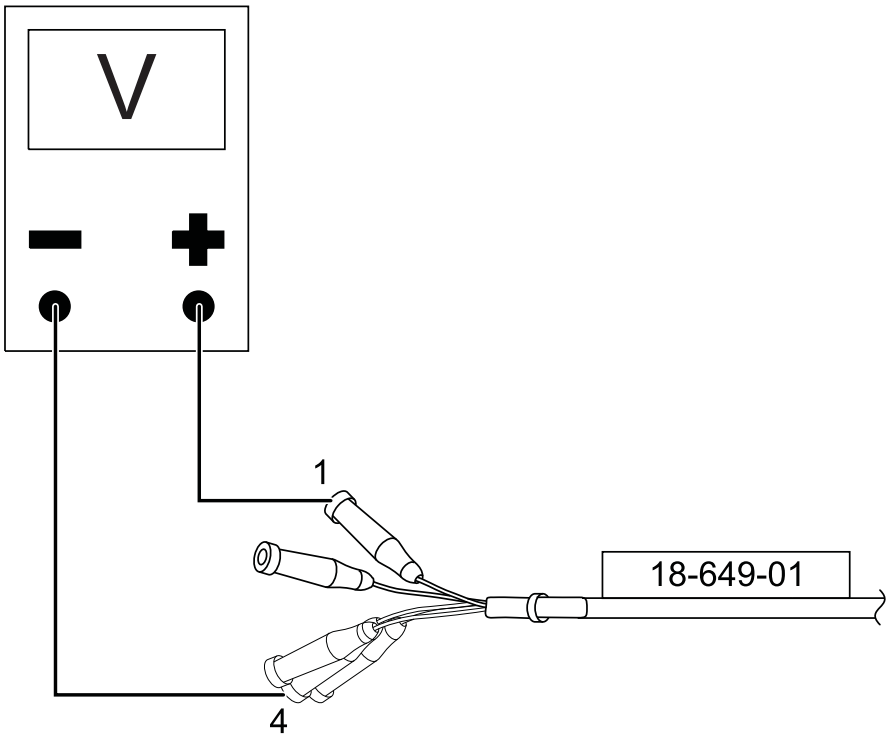


Figure 745 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 746 Test 1 Nitrogen Oxides Outlet Concentration (NOx Out) sensor circuit voltage check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-649-01 between Nitrogen Oxides Outlet Concentration (NOx Out) sensor and vehicle harness connector. C. Key ON.

Test 1	Specification
Using DMM, measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volt
Decision	
Is voltage B+ ± 0.5 volt?	Yes: Replace NOx Out sensor. After repairs are complete, retest for SPN 3226 FMI 2.
	No: Go to Test 2.

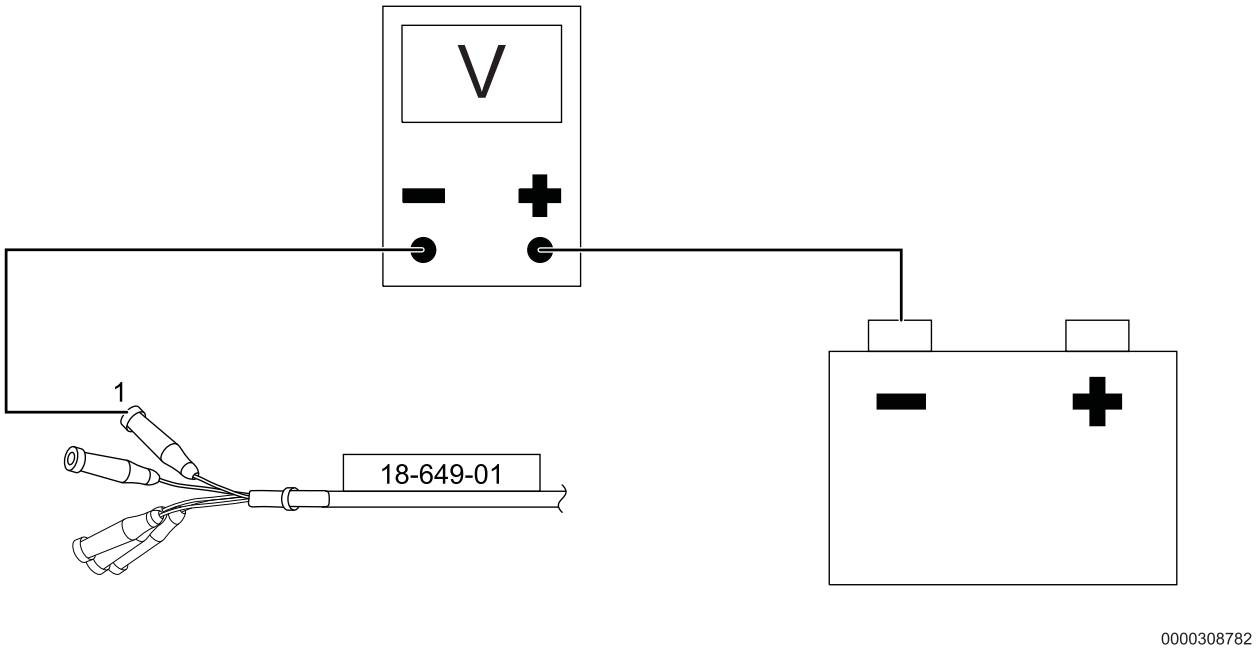


Figure 747 Test 2 Nitrogen Oxides Outlet Concentration (NOx Out) sensor circuit voltage check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-649-01 between Nitrogen Oxides Outlet Concentration (NOx Out) sensor and vehicle harness connector. C. Key ON.

Test 2	Specification
Using DMM, measure voltage between Breakout Harness 18-649-01 pin-1 and known good ground.	B+ ± 0.5 volt
Decision	
Is voltage B+ ± 0.5 volt?	Yes: Repair Open or high resistance between NOx Out sensor pin-4 and GND. After repairs are complete, retest for SPN 3226 FMI 2.
	No: Repair Open or short to ground between NOx Out sensor connector pin-1 and switched ignition relay pin-87. After repairs are complete, retest for SPN 3226 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3226 FMI 2 fault code diagnostics.

SPN 3226 FMI 4 - NOxOUT signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Outlet Concentration (NOx Out) sensor voltage below normal or shorted to low source.	Failed NOx Out sensor	Processing of fail messages from sensor enabled 160 seconds after dew point reached. Dew point is defined as: Exhaust gas temperature is above threshold representing the point at which there is no longer concern of condensation on NOx Out sensor element

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects an internal circuit error in Nitrogen Oxides Outlet Concentration (NOx Out) sensor for 10 seconds. Engine torque will be reduced if engine is operated for limited period of time with fault code active. Engine torque will be severely reduced and vehicle speed will be limited after extended engine operation with fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 3228 FMI 2 (NOx Out)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx Out sensor

Step 1	Check for associated fault code	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1866). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 4.

Step 2	Inspect connections at Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	A. Key OFF. B. Disconnect NOx Out sensor. C. Check NOx Out sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx Out sensor module connector, harness, and terminals clean and undamaged?	Yes: Replace NOx Out sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 4.
		No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 4.

End Diagnostic Steps
After doing all diagnostic steps, if SPN 3226 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3226 FMI 10 - NOx OUT Signal Abnormal Rate of Change

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxide Out (NOx Out) sensor reading is not valid.	Percent of time > 50 % when NOx Out sensor reading is valid since the internal control loops within sensor have stabilized	Engine total fueling > 0.01 and rate of active / intrusive injection of fuel in exhaust < 0.2 g/sec for 30 seconds. Internal NOx sensor temperature > 1472°F (800°C) Changing range of exhaust O_2 concentration within 12 second moving window ≤ 9.96 Changing range of exhaust O_2 concentration within 6 second moving window ≤ 5.43 Exhaust gas temperature is above threshold representing point at which there is no longer concern of condensation on NOx sensor element and sensor supply power ≥ 6 volts for 150 seconds Inactive: SPN 3226 FMI 4, SPN 3226 FMI 9, and SPN 3228 FMI 3.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Nitrogen Oxides Outlet Concentration (NOx Out) sensor signal is invalid for 300 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 FMI 3 and 4 (NOx Out)	• SPN 3228 FMI 2 (NOx Out)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx Out sensor

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1868). Is EST DTC list free of Associated Faults?	Yes: Replace NOx Out sensor module. After repairs are complete, retest for SPN 3226 FMI 10.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3226 FMI 10.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3226 FMI 10 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3226 FMI 13 - NOxOUT Out of Calibration

Condition / Description	Setting Criteria	Enable Conditions / Values
Calibration mismatch between Nitrogen Oxides Outlet Concentration (NOx Out) sensor and Aftertreatment Control Module (ACM).	Rated NOx Out sensor voltage does not match nominal system voltage	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Nitrogen Oxides Outlet Concentration (NOx Out) sensor voltage rating does not match engine's electrical system voltage.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed or incorrectly installed NOx Out sensor

Step 1	Check for correct Nitrogen Oxides Outlet Concentration (NOx Out) sensor module.	Decision
	Verify correct NOx Out sensor module is installed. Is correct NOx Out sensor module installed?	Yes: Replace NOx Out sensor module. After repairs are complete, retest for SPN 3226 FMI 13.
		No: Install correct NOx Out sensor module. After repairs are complete, retest for SPN 3226 FMI 13.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3226 FMI 13 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3226 FMI 19 - NOxOUT not detected on J1939

Condition / Description	Setting Criteria	Enable Conditions / Values
Loss of communication or invalid data from Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Aftertreatment Control Module (ACM) loses J1939 data link communications with NOx Out sensor module	Key ON Engine not cranking Data link-related faults are inhibited for a calibration adjustable amount of time following a Key-ON event, a low battery voltage event, an engine cranking event, and a stop / suspend broadcast event. This is to allow reasonable time for data link devices to power up and begin periodic broadcasts before the ECM performs time-out diagnostics.

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) loses J1939 data link communications with Nitrogen Oxides Outlet Concentration (NOx Out) sensor. Diesel exhaust Fluid (DEF) injection into aftertreatment system is disabled, and engine torque will be severely reduced.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

If more than one of the following sensor modules fail (or set a fault), suspect a common power circuit, ground circuit, or switched ignition relay problem. The following components share power and ground circuits: DOC / DPF temperature sensor module, SCR temperature sensor module, Ammonia Sensor Module, NOx OUT sensor module, NOx IN sensor module, and Diesel Exhaust Fluid Tank Level / Temperature (DEFTLT) sensor module.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- SWBAT circuit Open or short to GND
- CAN-AH circuit Open or short to GND
- CAN-AL circuit Open or short to GND
- CAN-AH circuit short to power
- CAN-AL circuit short to power
- GND circuit Open or high resistance
- CAN AH short to CAN AL
- Failed NOx Out sensor

Step 1	Inspect connections at Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	A. Key OFF. B. Disconnect NOx Out sensor. C. Check NOx Out sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx Out sensor connector, harness, and terminals clean and undamaged?	Yes: Go to Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3226 FMI 19.

Pin-Point Tests (SPN 3226 FMI 19)

NO_X Out Circuit

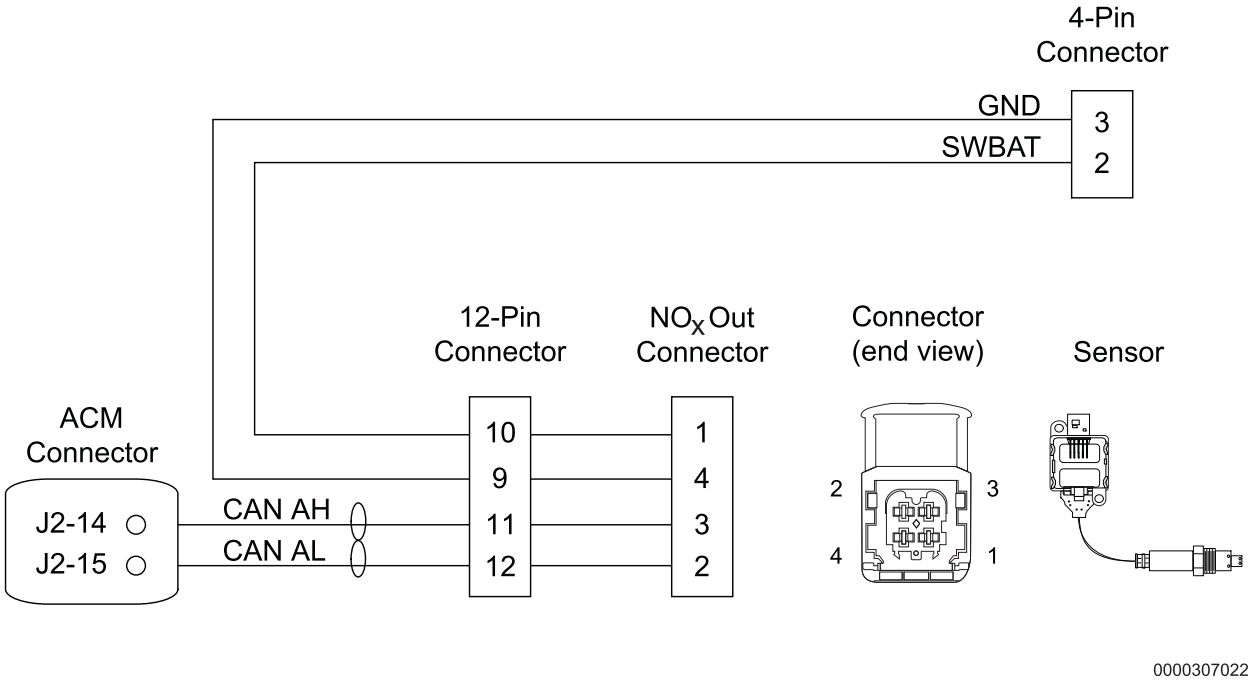


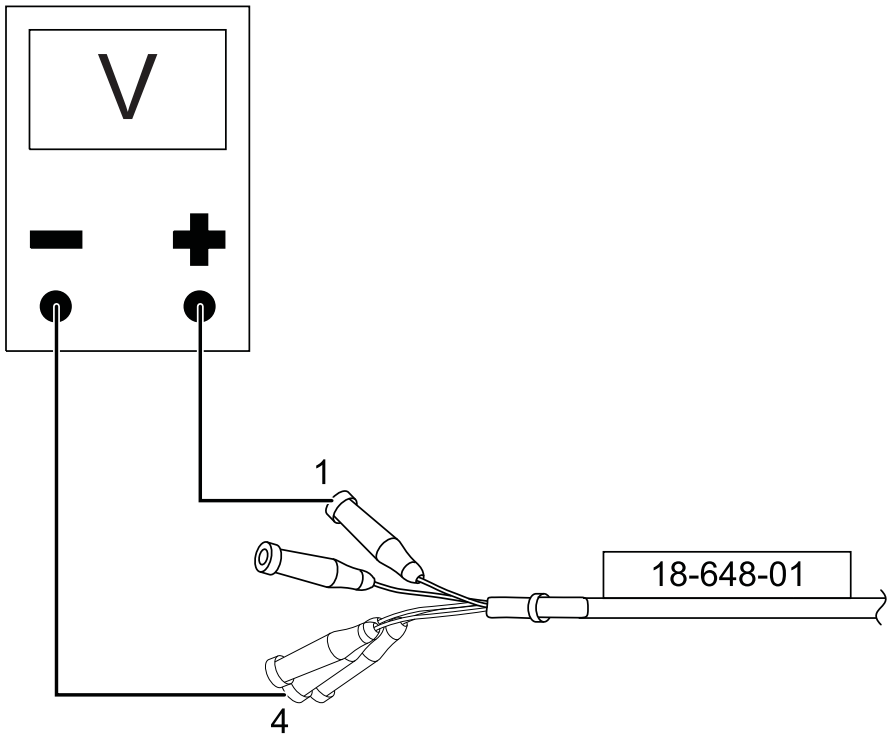
Figure 748 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 and Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Verify batteries are fully charged and connections are clean.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)



0000308508

Figure 749 Test 1 NOx Out Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 2.

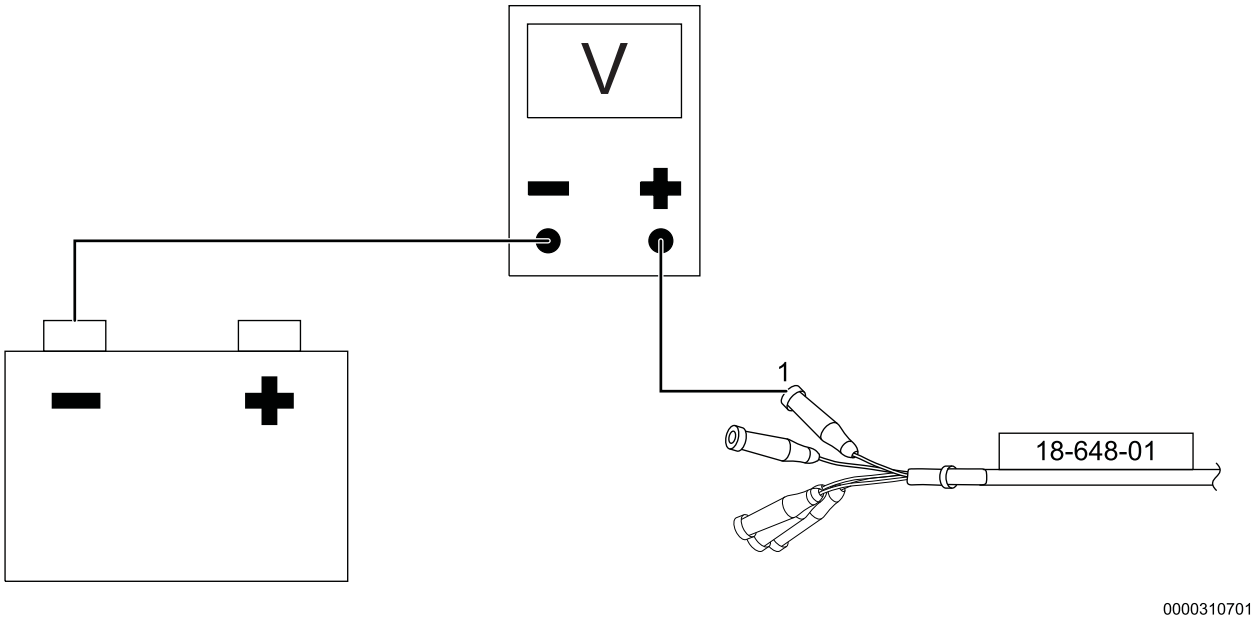


Figure 750 Test 2 NOx Out Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between NOx Out sensor pin-4 and ground. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.
	No: Repair Open or short to ground between NOx Out sensor connector pin-1 and switched ignition relay pin-87. After repairs are complete, SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.

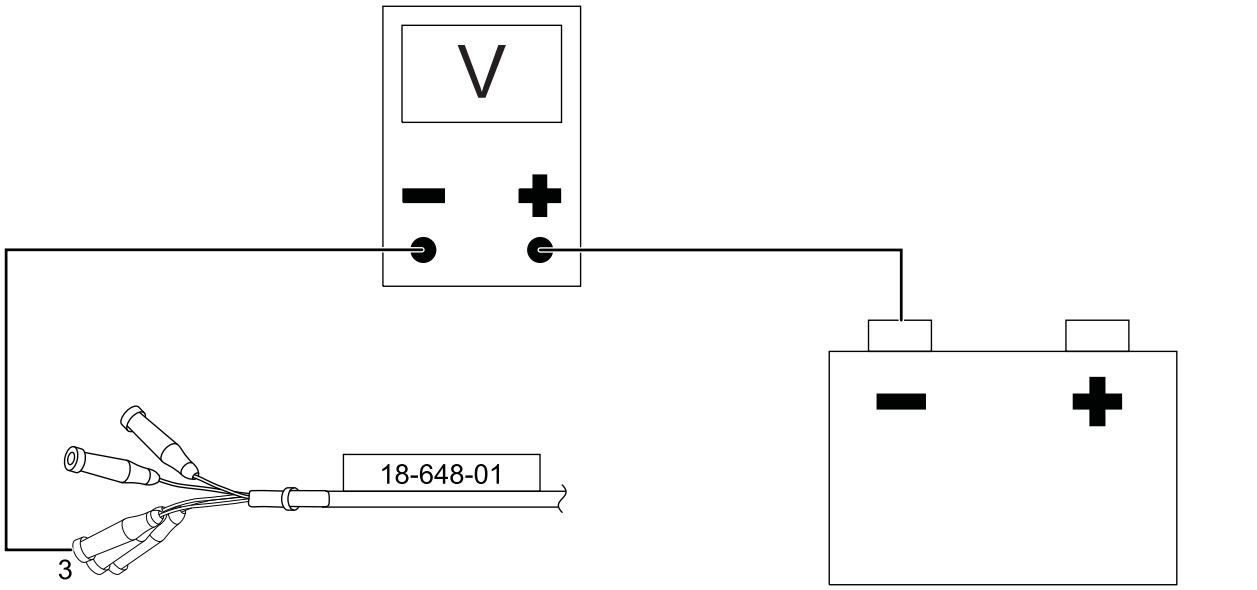


Figure 751 Test 3 NOx Out Sensor Module Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-3 and known good ground.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 4.
	No: Repair Open or short to ground between NOx Out sensor connector pin-3 and ACM connector pin J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.

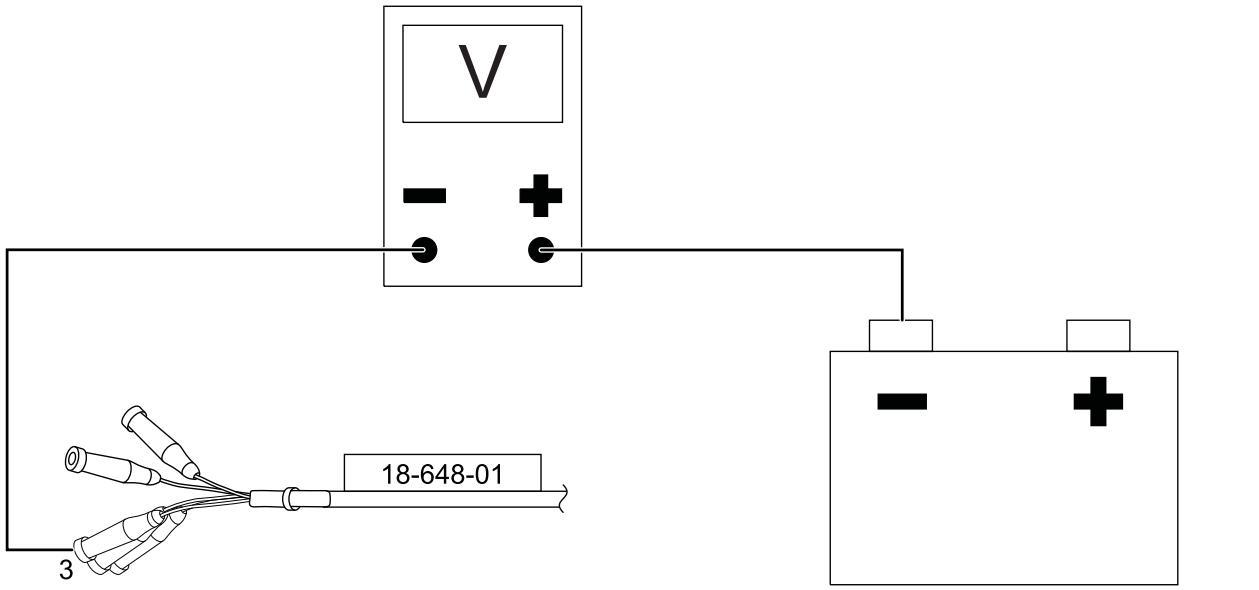


Figure 752 Test 4 NOx Out Sensor Module Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 4	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-3 and known good ground.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 5.
	No: Repair short to PWR between NOx Out sensor connector pin-3 and ACM connector pin J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.

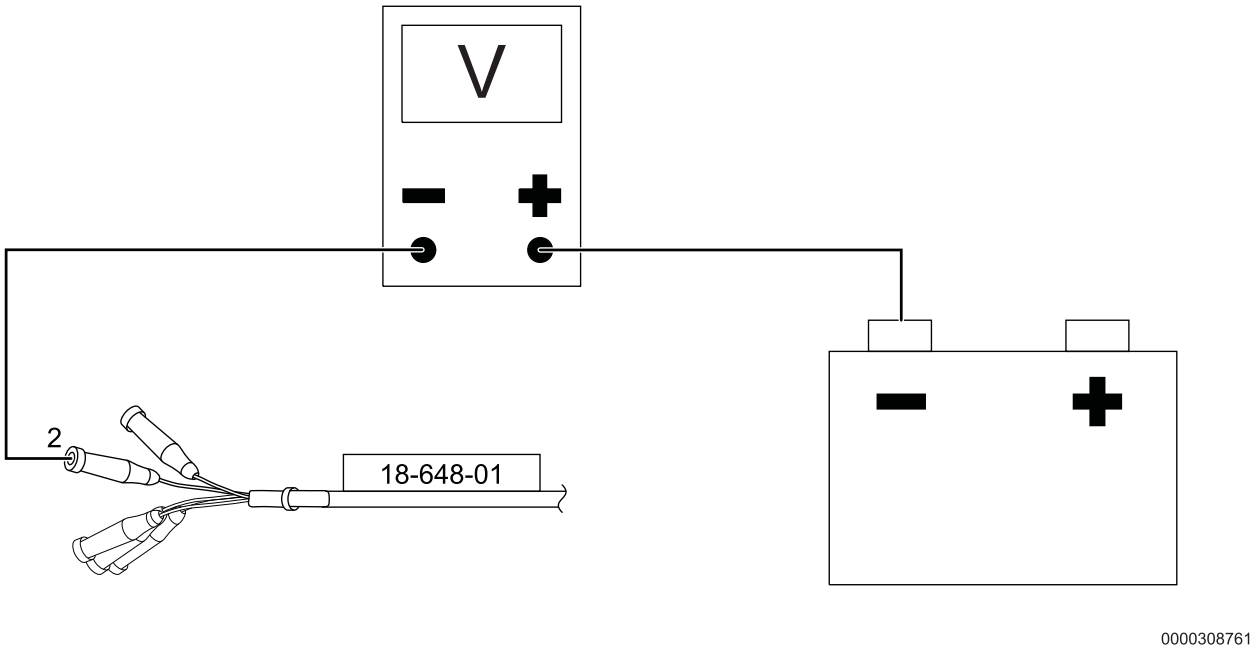


Figure 753 Test 5 NOx Out Sensor Module Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 5	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-2 and known good ground.	Greater than 1 volt
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 6.
	No: Repair Open or short to ground between NOx Out sensor connector pin-2 and ACM connector pin J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.

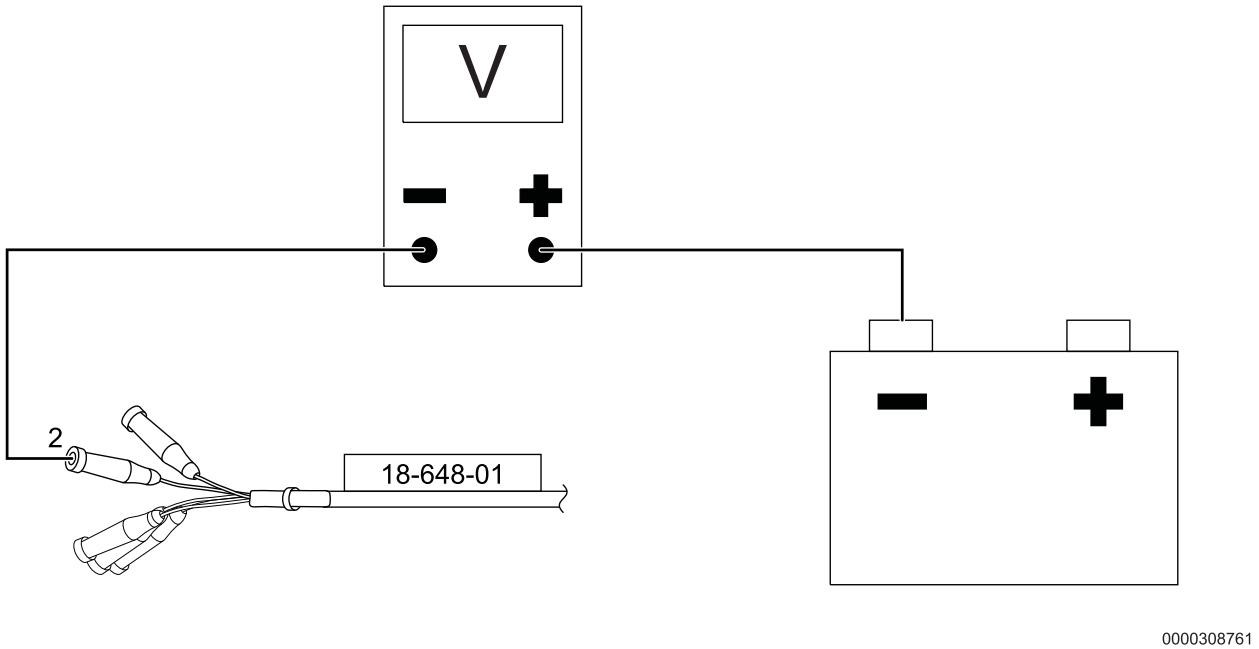
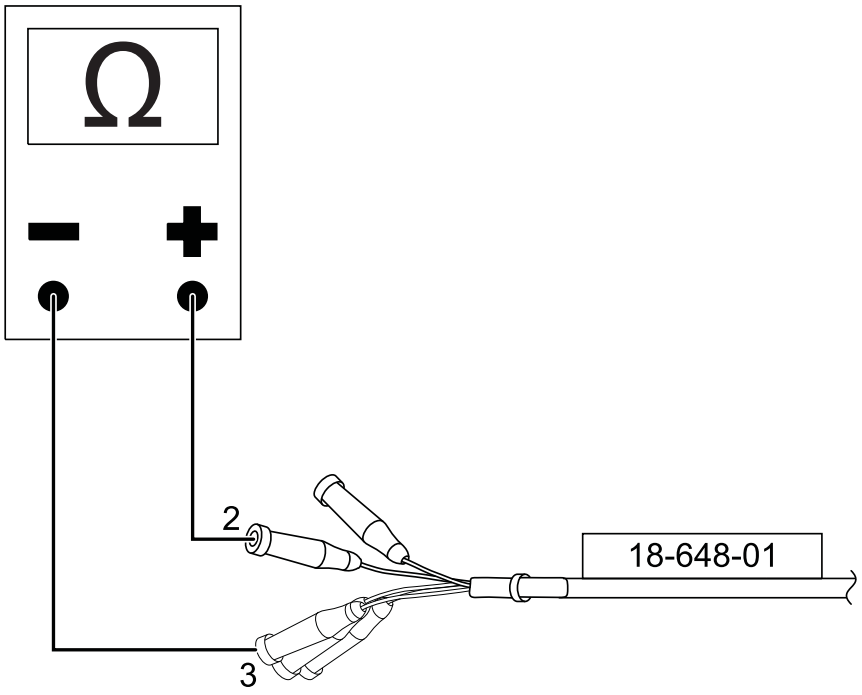


Figure 754 Test 6 NOx Out Sensor Module Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector. C. Key ON.

Test 6	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-2 and known good ground.	Less than 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 7.
	No: Repair short to power between NOx Out sensor connector pin-2 and ACM connector pin J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.



0000308762

Figure 755 Test 7 NOx Out Sensor Module Circuit Resistance Check

Test 7 Setup
A. Disconnect batteries. B. Connect Breakout Harness 18-648-01 between NOx Out sensor module and vehicle harness connector.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness 18-648-01 pin-2 and pin-3.	Greater than 50 ohms
Decision	
Is resistance greater than 50 ohms?	Yes: Replace NOx Out sensor. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.
	No: Repair short between NOx Out sensor connector pin-2 and pin-3. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 3226 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3226 FMI 19 fault code diagnostics.

SPN 3226 FMI 20 - NOxOUT signal drifted HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Control Module (ACM) determines Nitrogen Oxides Outlet Concentration (NOx Out) sensor signal drifted HIGH.	Average value of NOx Out sensor offset measurement at the decision point > 40 ppm	Engine total fueling ≤ 0.01 mg/stroke NOx Out sensor reading is valid since internal control loops within sensor have stabilized Engine is operating in base mode Exhaust flow ≥ 100 g/sec Commanded Diesel Exhaust Fluid (DEF) injection rate < 0.1 ml/sec None of the abort conditions are satisfied Other enable conditions must be true for at least 6 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) determines signal from Nitrogen Oxides Outlet Concentration (NOx Out) sensor is high during monitoring conditions, or is not changing with engine conditions.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 FMI 4 (NOx Out)	• SPN 3228 FMI 2 (NOx Out)	• SPN 5031 FMI 10 (NOx Out)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Improperly installed NOx Out sensor
- Crystallization of decomposition tube
- Failed NOx Out sensor

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1882). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3226 FMI 20.

Step 2	Verify proper installation of Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	Check NOx Out sensor retaining nut and NOx Out sensor retaining cap screws for proper torque. Is NOx Out sensor properly installed?	Yes: Go to Step 3.
		No: Properly install NOx Out sensor. After repairs are complete, retest for SPN 3226 FMI 20.

Step 3	Check decomposition tube for crystallization.	Decision
	Disconnect decomposition tube from exhaust system (see *Exhaust Aftertreatment with DPF and SCR Service Manual*) and inspect for Diesel Exhaust Fluid (DEF) crystallization. Is decomposition tube free of DEF crystallization?	Yes: Replace Nitrogen Oxides Outlet Concentration (NOx Out) sensor. After repairs are complete, retest for SPN 3226 FMI 20.
		No: Remove DEF crystallization from decomposition tube (see *Exhaust Aftertreatment with DPF and SCR Service Manual*). After repairs are complete, retest for SPN 3226 FMI 20.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3226 FMI 20 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3226 FMI 21 - NOxOUT signal drifted LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment Control Module (ACM) determines Nitrogen Oxides Outlet Concentration (NOx Out) sensor signal drifted LOW.	Average value of NOx Out sensor offset measurement at the decision point < - 40 ppm	Engine total fueling ≤ 0.01 mg/stroke NOx Out sensor reading is valid since internal control loops within sensor have stabilized. Engine is operating in base mode. Exhaust flow ≥ 100 g/sec Commanded Diesel Exhaust Fluid (DEF) injection rate < 0.1 ml/sec None of the abort conditions are satisfied Other enable conditions must be true for at least 6 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects reading from Nitrogen Oxides Outlet Concentration (NOx Out) sensor is low during monitoring conditions, or is not changing with engine conditions.

Lamp Reaction

Malfunction Indicator Lamp (MIL)will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 FMI 4 (NOx Out)	• SPN 3228 FMI 2 (NOx Out)	• SPN 5031 FMI 10 (NOx Out)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Improperly installed NOx Out sensor
- Failed NOx Out sensor

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1884). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3226 FMI 21.

Step 2	Verify proper installation of Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	Check NOx Out sensor retaining nut and NOx Out sensor retaining cap screws for proper torque. Is NOx Out sensor properly installed?	Yes: Replace NOx Out sensor. After repairs are complete, retest for SPN 3226 FMI 21.
		No: Properly install the NOx Out sensor. After repairs are complete, retest for SPN 3226 FMI 21.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3226 FMI 21 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 3228 FMI 2 - NOxOUT power supply signal erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Outlet Concentration (NOx Out) sensor circuitry has detected that its battery supply voltage is outside desired range.	NOx Out sensor supply voltage > 16.5 V for 10 seconds OR NOx Out sensor supply voltage < 11.4 V for 10 seconds.	160 seconds after exhaust gas temperature is above threshold representing point there is no battery voltage on the NOx sensor element.

Fault Overview

Fault code sets when Engine Control Module (ECM) detects power supply to Nitrogen Oxides Outlet Concentration (NOx Out) sensor is above or below a calibration adjustable threshold.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 168 FMI 16, and 18 (ACM PWR)	• SPN 3226 FMI 9 (NOx Out)		

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx Out sensor
- SWBAT circuit intermittent short to GND or Open
- GND circuit Open or high resistance
- Power Distribution Module (PDM) loose fuse or relay
- Low battery voltage
- Incorrect NOx Out sensor installed

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1886). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3228 FMI 2.

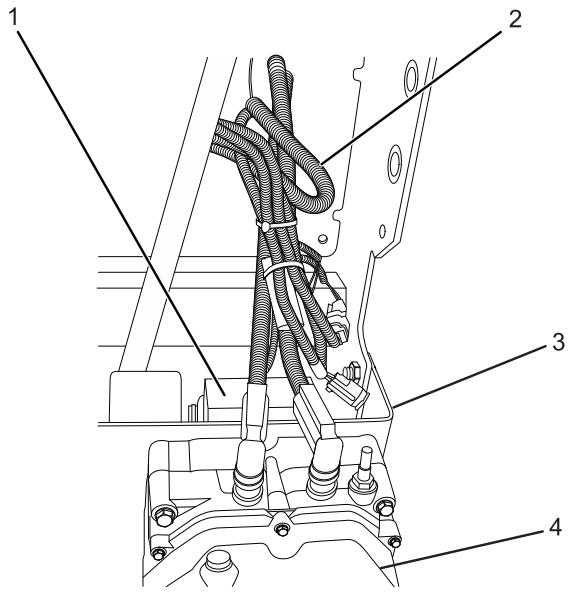


Figure 756 PDM Location (typical)

1. Power Distribution Module (PDM)
2. Diesel Exhaust Fluid (DEF) tank assembly
3. DEF supply module bracket
4. DEF supply module

Step 2	Check Power Distribution Module (PDM) fuse(s) and relay(s)	Decision
	A. Key OFF. B. Check PDM fuse(s) and relay(s) for blown fuses; loose, missing, or intermittent connections. Are all fuses and relays securely attached and in good condition?	Yes: Go to Step 3. No: Secure or replace failed fuse(s) or relay(s) to PDM connector. After repairs are complete, retest for SPN 3228 FMI 2.

Step 3	Inspect connections at Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	A. Key OFF. B. Disconnect NOx Out sensor. C. Check NOx Out sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx Out sensor, connector, harness, and terminals clean and undamaged?	Yes: Pin-Point Tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 3228 FMI 2.

Step 4	Check for incorrect Nitrogen Oxides Outlet Concentration (NOx Out) sensor installed.	Decision
	Check for incorrect NOx Out sensor installed. Is the correct NOx Out sensor installed?	Yes: Replace NOx Out sensor. After repairs are complete, retest for SPN 3228 FMI 2.
		No: Install correct NOx Out sensor. After repairs are complete, retest for SPN 3228 FMI 2.

Pin-Point Tests (SPN 3228 FMI 2)

NO_X Out Circuit

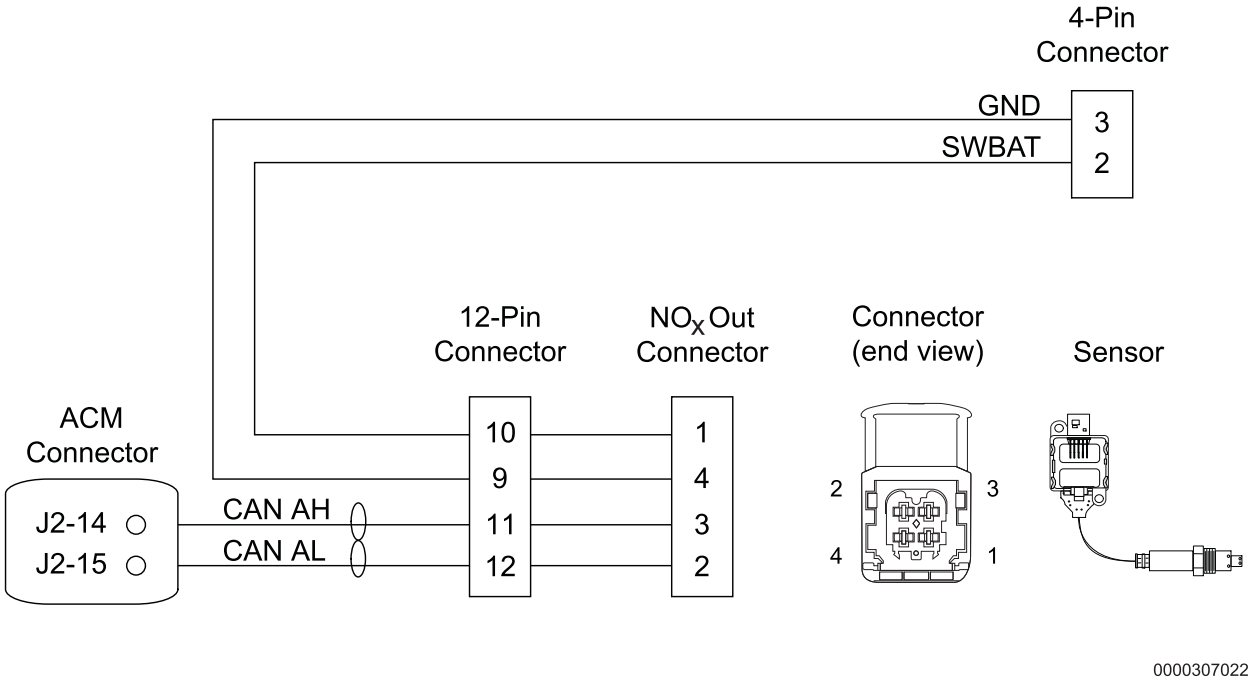
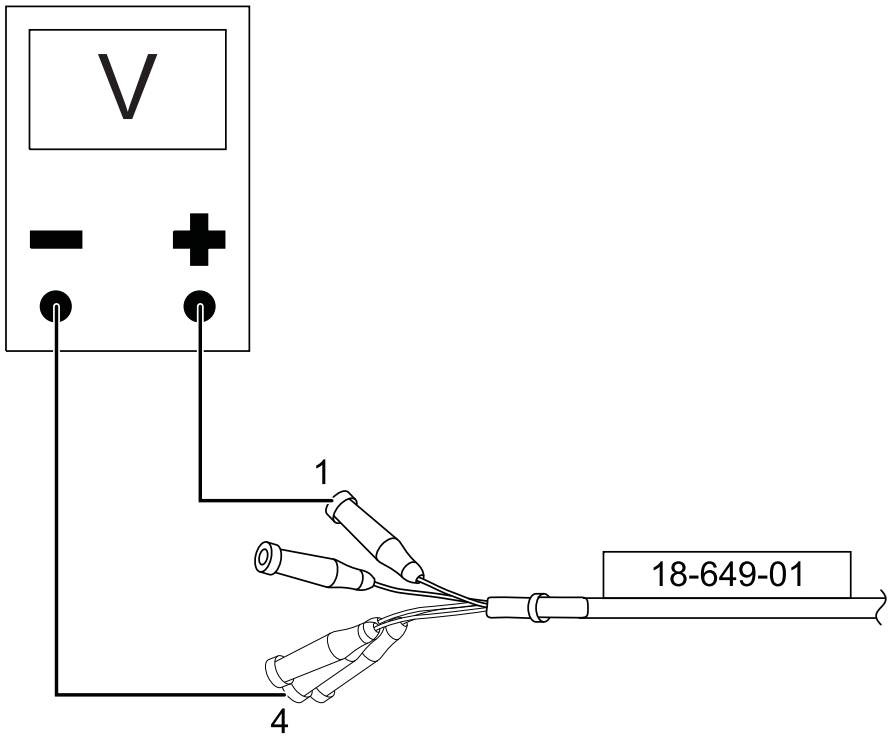


Figure 757 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 758 Test 1 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Voltage Check

Test 1 Setup
A. Key OFF B. Connect breakout Harness 18-649-01 between Nitrogen Oxides Outlet Concentration (NOx Out) sensor and vehicle harness connector. C. Key ON

Test 1	Specification
Use DMM to measure voltage between 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Step 3.
	No: Go to Test 2.

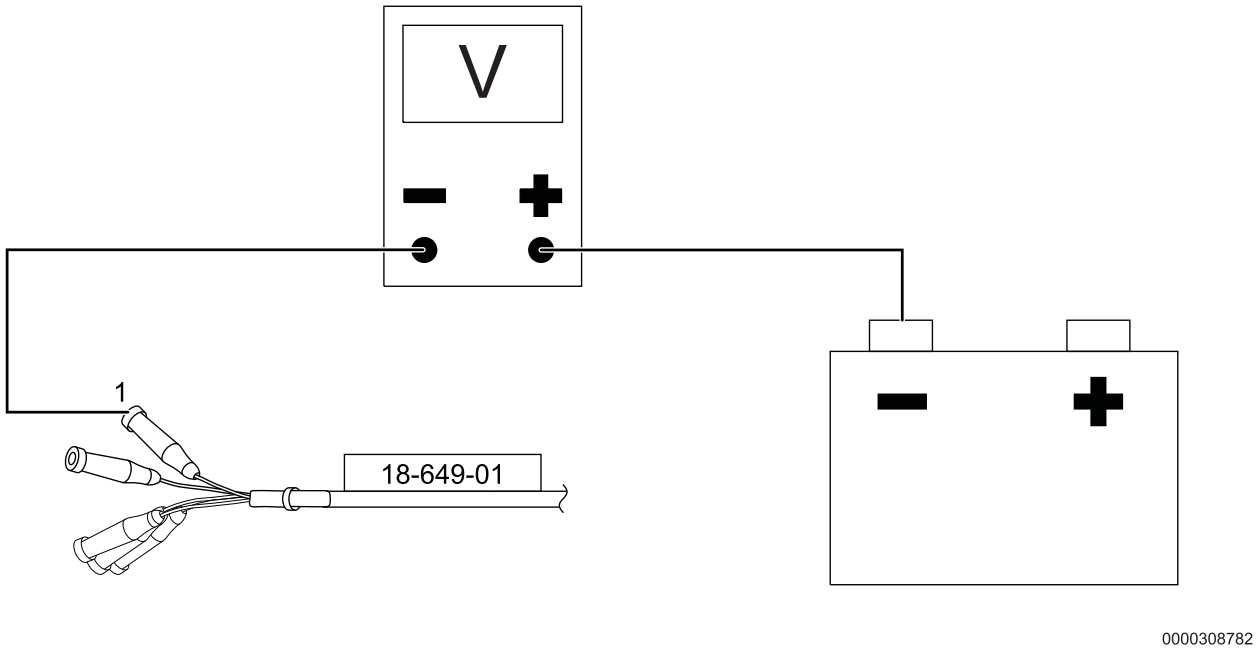


Figure 759 Test 2 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Voltage Check

Test 2 Setup
A. Key OFF B. Connect breakout Harness 18-649-01 between Nitrogen Oxides Outlet Concentration (NOx Out) sensor and vehicle harness connector. C. Key ON

Test 2	Specification
Use DMM to measure voltage between NOx Out sensor pin-1 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between NOx Out sensor pin-4 and ground. After repairs are complete, retest for SPN 3228 FMI 2.
	No: Repair Open or short to ground between NOx Out sensor connector pin-1 and power. After repairs are complete, retest for SPN 3228 FMI 2.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 3228 FMI 2 fault code diagnostics.

SPN 5024 FMI 10 - NOxIN Sensor Heater abnormal rate of change

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Intake Concentration (NOx In) sensor heater is unable to maintain its operating temperature.	NOx In sensor heater temperature does not match Aftertreatment Control Module (ACM) predetermined values	Diesel Oxidation Catalyst Intake Temperature (DOCIT) > 302°F (150°C) for 5 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxides Intake Concentration (NOx In) sensor heater was unable to maintain its normal operating temperature.

Lamp Reaction

When fault is active, Malfunction Indicator Lamp (MIL) will not illuminate.

Associated Faults

• SPN 3216 FMI 4 and 9 (NOx In)	• SPN 3218 FMI 2 (NOx In)	• SPN 4765 FMI 2, 3, and 4 (DOCIT)	

Fault Facts

If more than one of following sensor modules fail (or set a fault), suspect a common power circuit, ground circuit, or switched ignition relay problem. Following components share power and ground circuits with the NOx In sensor: Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor; Nitrogen Oxides Outlet Concentration (NOx Out) sensor; Nitrogen Oxides Intake Concentration (NOx In) sensor; Aftertreatment Ammonia (NH3) sensor; and Diesel Exhaust Fluid Tank Level and Temperature (DEF: TL and DEF: TT) sensor.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx In sensor
- GND circuit Open or high resistance
- SWBAT circuit Open or high resistance

Verify batteries are fully charged and connections are clean.

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1893). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 5024 FMI 10.

Step 2	Inspect connections at Nitrogen Oxides Intake Concentration (NOx In) sensor.	Decision
	A. Key OFF. B. Disconnect NOx In sensor connector. C. Check NOx In sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx In sensor, connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5024 FMI 10.

Pin-Point Tests (SPN 5024 FMI 10)

NO_X In Circuit

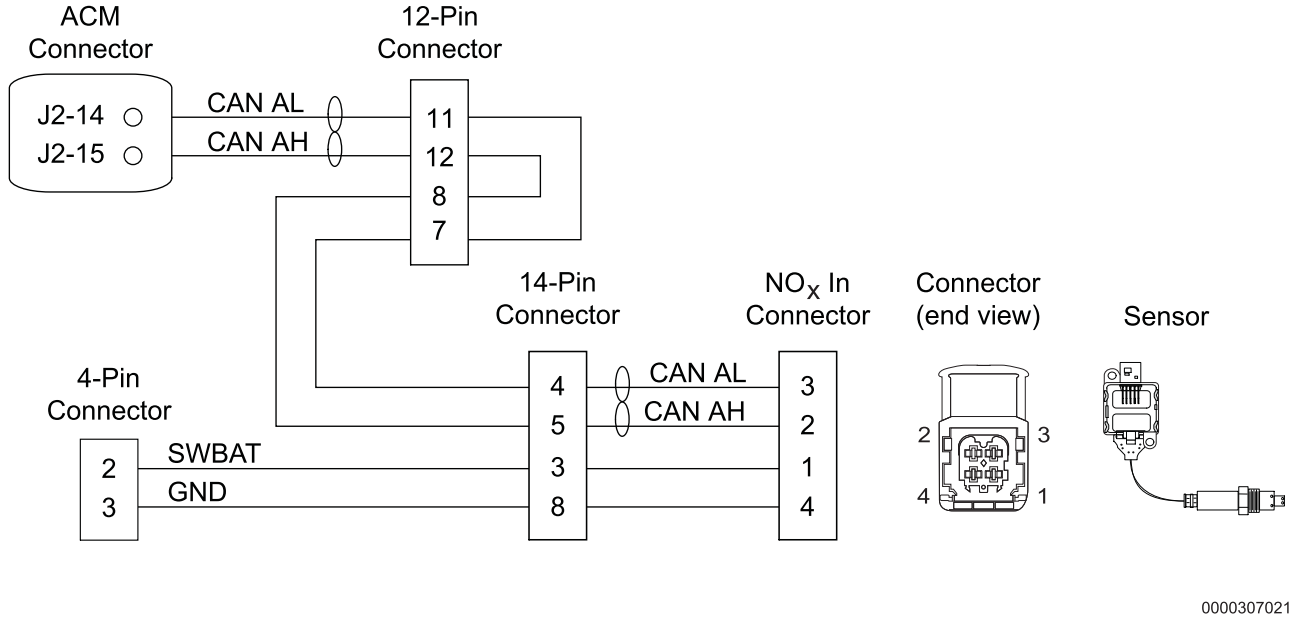
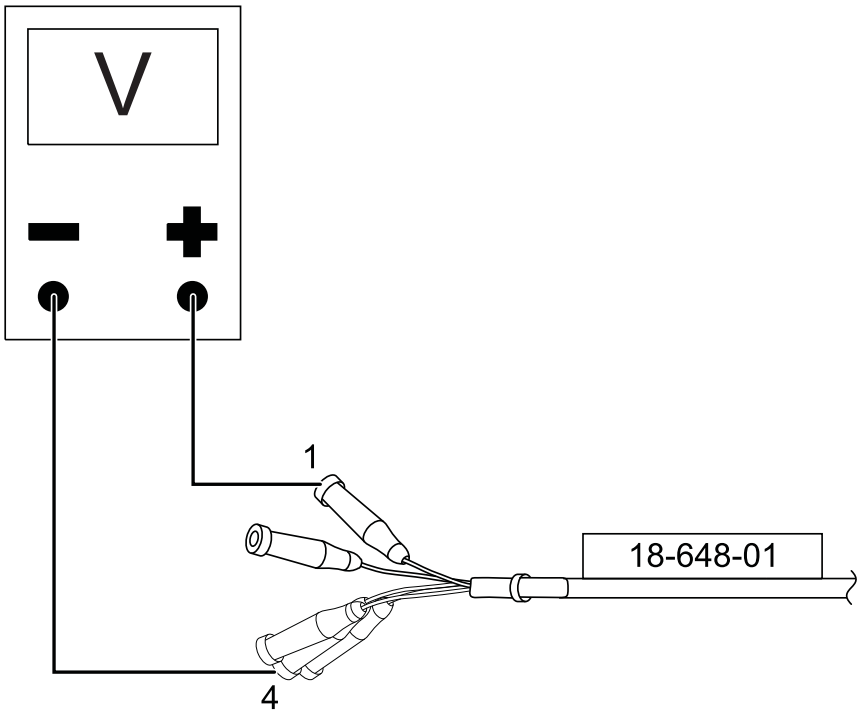


Figure 760 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)



0000308508

Figure 761 Test 1 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor module harness connector. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 2.
	No: Replace NOx In sensor module. After repairs are complete, retest for SPN 5024 FMI 10.

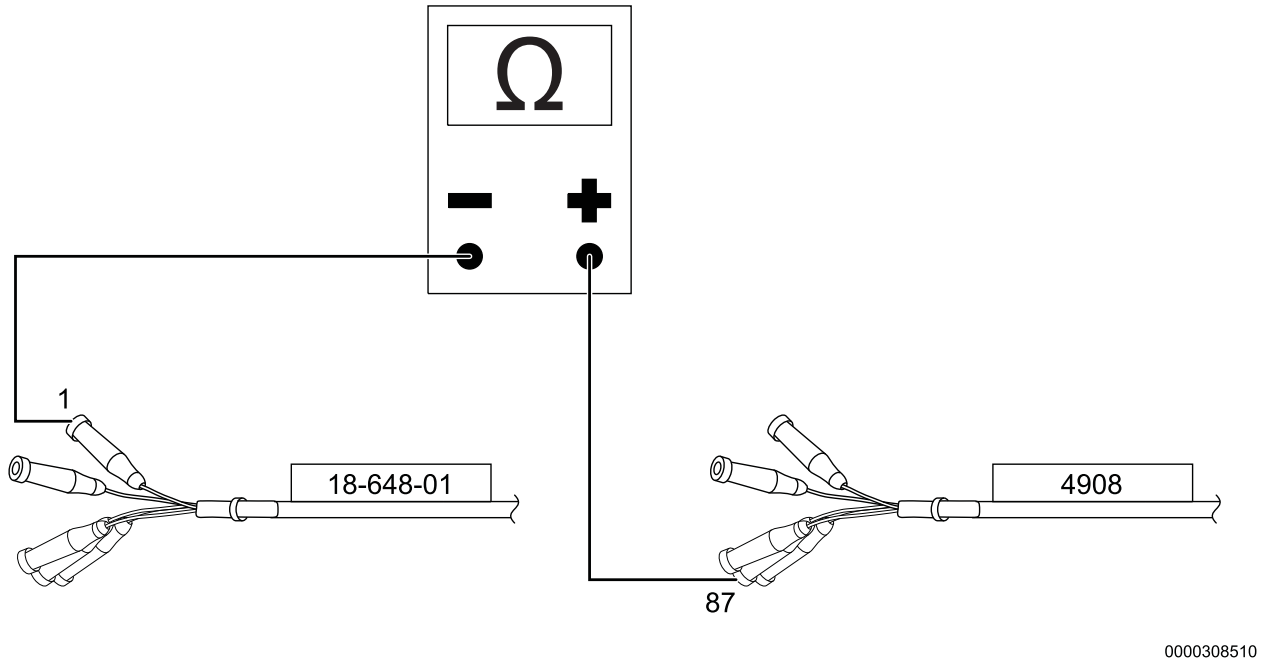


Figure 762 Test 2 Nitrogen Oxides Intake Concentration (NOx In) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Nitrogen Oxides Intake Concentration (NOx In) sensor module harness connector and leave sensor disconnected. C. Connect Breakout Harness ZTSE4908 to switched ignition relay and leave disconnected.

Test 2	Specification
Use DMM to measure resistance between Breakout Harness 18-648-01 pin-1 and Breakout Harness ZTSE4908 pin-87.	Less than 5 ohms
Decision	
Is resistance less than 5 ohms?	Yes: Repair Open or high resistance between NOx In sensor module pin-4 and ground. After repairs are complete, retest for SPN 5024 FMI 10.
	No: Repair Open or high resistance between NOx In sensor module pin-1 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5024 FMI 10.

End Pin-Point Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 5024 FMI 10 fault code diagnostics.

SPN 5031 FMI 10 - NOxOUT Sensor Heater not reading correctly

Condition / Description	Setting Criteria	Enable Conditions / Values
Nitrogen Oxides Outlet Concentration (NOx Out) sensor heater is unable to maintain normal operating temperature.	NOx Out sensor heater temperature does not match Aftertreatment Control Module (ACM) predetermined values	Diesel Oxidation Catalyst Intake Temperature (DOCIT) > 302°F (150°C) for 5 seconds Selective Catalyst Reduction Outlet Temperature (SCROT) < 800°C Key-On Engine-Running (KOER) Inactive: SPN 3226 FMI 4 and 13; SPN 3228 FMI 2; SPN 4360 FMI 2; SPN 4363 FMI 2, 3, and 4; SPN 5743 FMI 3, 4, and 11. Exhaust gas velocity < 60 m/sec Exhaust gas temperature is above threshold representing the point at which there is no longer concern of condensation on the NOx Out sensor element. Time after NOx Out sensor has reached its working temperature and has entered automatic mode > 30 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxides Outlet Concentration (NOx Out) sensor heater was unable to maintain its normal operating temperature.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 FMI 4 (NOx Out)	• SPN 3228 FMI 2 (NOx Out)	• SPN 4360 FMI 2 (SCRIT)	• SPN 4363 FMI 2, 3, and 4 (SCROT)

Fault Facts

If more than one of following sensor modules fail or set a fault, suspect a common power circuit, ground circuit, or switched ignition relay problem. The following components share power and ground circuits with the NOx Out sensor module: Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) temperature sensor module; Nitrogen Oxides Outlet Concentration (NOx Out) sensor module; Aftertreatment Ammonia (NH3) sensor module; Selective Catalyst Reduction (SCR) sensor module; and Diesel Exhaust Fluid Tank Level and Temperature (DEF: TL and DEF: TT) sensor.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed NOx OUT sensor module
- GND circuit Open or high resistance
- SWBAT circuit Open or high resistance

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1898). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5031 FMI 10.

Step 2	Inspect connections at Nitrogen Oxides Outlet Concentration (NOx Out) sensor.	Decision
	A. Key OFF. B. Disconnect NOx Out sensor connector. C. Check NOx Out sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are NOx Out sensor, connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5031 FMI 10.

Pin-Point Tests (SPN 5031 FMI 10)

NO_X Out Circuit

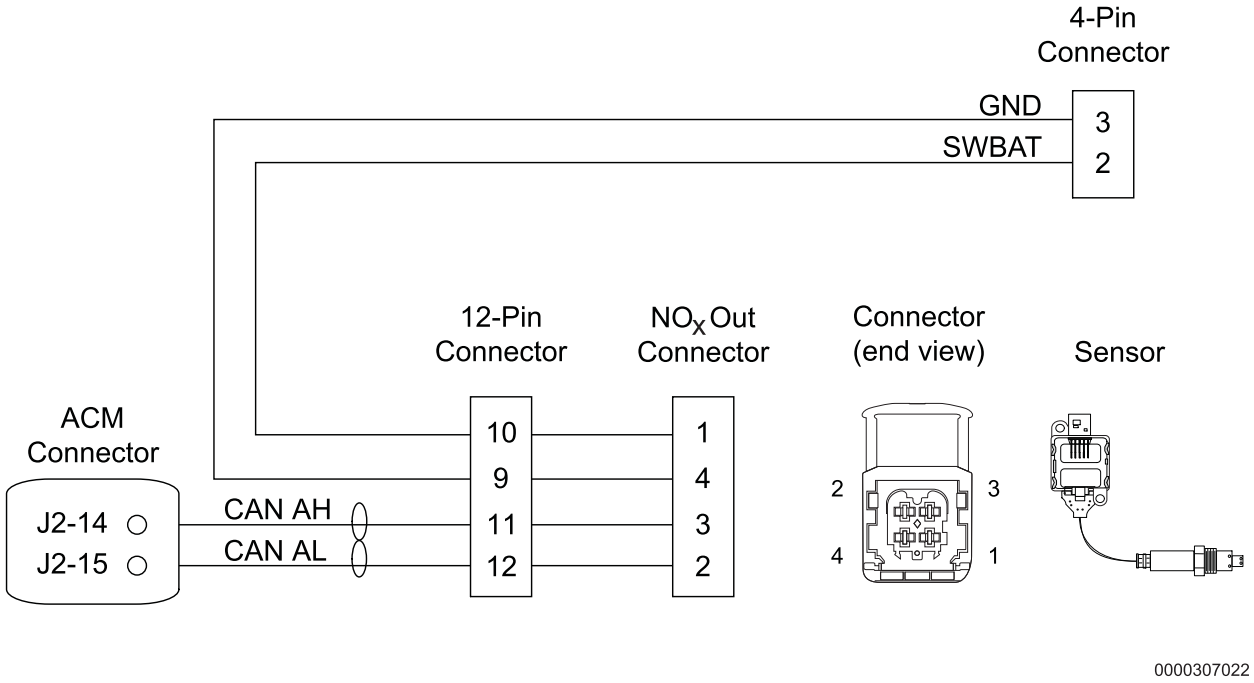


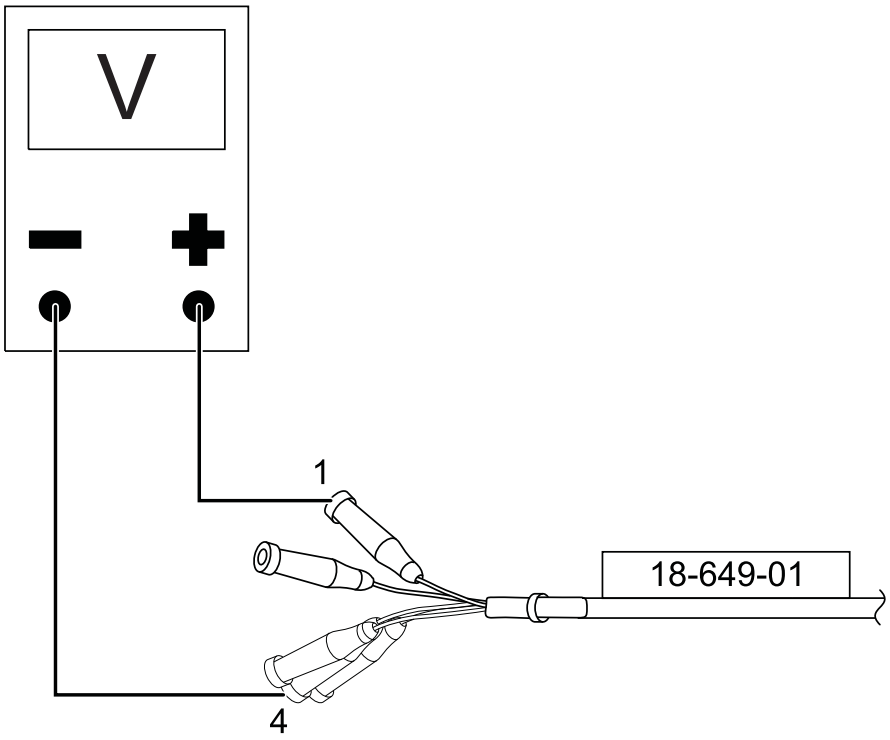
Figure 763 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Verify batteries are fully charged and connections are clean.

Tools Required

- Breakout Harness 18-649-01
- Digital Multimeter (DMM)



0000308227

Figure 764 Test 1 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-649-01 to Nitrogen Oxides Outlet Concentration (NOx Out) sensor module harness connector. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace NOx In sensor module. After repairs are complete, retest for SPN 5031 FMI 10.
	No: Go to Test 2.

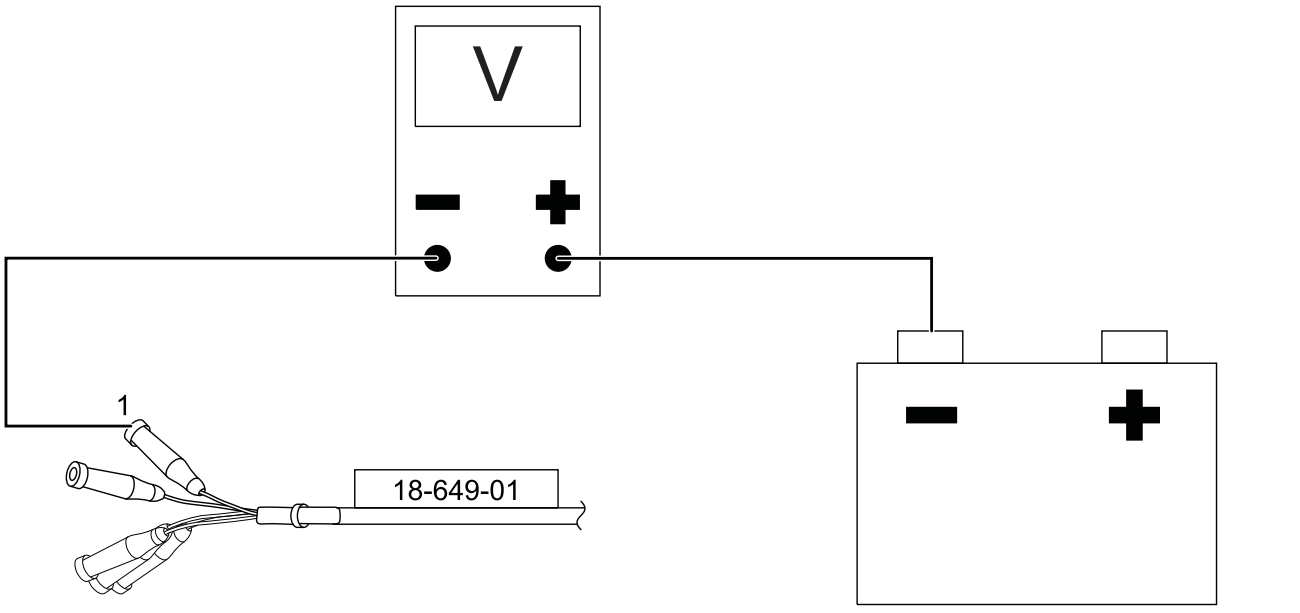


Figure 765 Test 2 Nitrogen Oxides Outlet Concentration (NOx Out) Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-649-01 to Nitrogen Oxides Outlet Concentration (NOx Out) sensor module harness connector and leave sensor disconnected. C. Key-On Engine-Off (KOEO).

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-649-01 pin-1 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between NOx Out sensor module pin-4 and ground. After repairs are complete, retest for SPN 5031 FMI 10.
	No: Repair Open or high resistance between NOx Out sensor module pin-1 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5031 FMI 10.

End Pin-Point Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 5031 FMI 10 fault code diagnostics.

RAPP (Remote APP) Sensor

Overview of RAPP Sensor Group

SPN	FMI	Description
974	3	Remote APP signal Out of Range HIGH (page 1905)

Overview

Remote Accelerator Pedal Position (RAPP) feature allows operator to set and maintain a constant engine speed from outside vehicle cab. This feature may also be know as Remote Engine Speed Control (RESC). Control over engine speed is accomplished by using remote mounted switches to turn on RAPP and select desired engine speed.

SPN 974 FMI 3 - Remote APP signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
TBD	TBD	TBD

Fault Overview

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

Fault Facts

Drive Cycle to Determine Fault Status

Possible Causes

•

Step 1	Check for active or pending fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN X FMI X. Is EST DTC list SPN X FMI X active or pending?	Yes: Go to Step 2.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at X connector.	Decision
	A. Key OFF. B. Disconnect X connector. C. Check X and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are X connector, harness, and terminals clean and undamaged?	Yes: Perform Pin-Point Test (page 1905).
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN X FMI X.

End Diagnostic Steps
After performing all diagnostic steps, if SPN X FMI X remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

Pin-Point Tests (SPN 974 FMI 3)

Tools Required

- 180-pin Breakout Box 00-00956-08
- Harness Kit (Overlay - pin identifier) 00-01462-00
- 3-Banana Plug Harness ZTSE4498
- Digital Multimeter (DMM) ZTSE4357
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

SCR (Temperature Sensor Module)

Overview of SCR Sensor Group

SPN	FMI	Condition
3061	31	CSER Exhaust warm up time fault (page 1909)
4364	18	Low NOx Conversion Detected (page 1913)
4792	7	SCR Catalyst System - Mechanical system not responding or out of adjustment (page 1919)
4792	14	SCR Temperature Module (Incorrect Part) (page 1921)
4794	31	SCR Catalyst System Missing (page 1923)
5743	3	SCR Thermocouple Controller Out of Range HIGH (page 1926)
5743	4	SCR Thermocouple Controller Out of Range LOW (page 1930)
5743	11	SCR Thermocouple Controller signal erratic, intermittent, or incorrect (page 1935)
5743	16	SCR Thermocouple Controller above Maximum Temperature (page 1941)
5743	19	SCR Temperature module not detect J1939 (page 1943)

Overview

Selective Catalyst Reduction (SCR) temperature sensor module monitors signals from SCR Intake Temperature (SCRIT), and SCR Outlet Temperature (SCROT) sensors, and communicates to Aftertreatment Control Module (ACM) over Controller Area Network (CAN). Engine torque will be reduced if engine is operated for a limited period of time with this fault code active. Engine torque will be reduced and vehicle speed will be limited after extended engine operation with fault active.

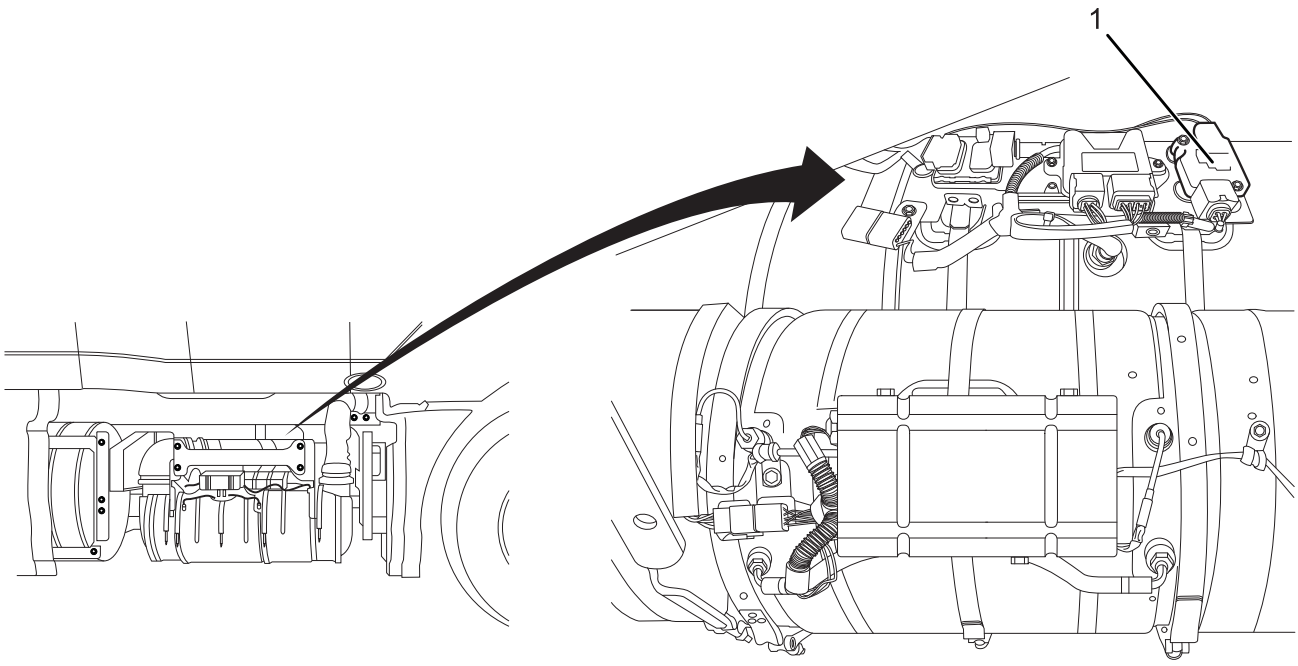


Figure 766 Selective Catalyst Reduction (SCR) Temperature Sensor Module Location

1. SCR temperature sensor module

SPN 3061 FMI 31 - CSER Exhaust warm up time fault

Condition / Description	Setting Criteria	Enable Conditions / Values
Monitor time for exhaust system to warm up. Threshold time is a function of engine operation, altitude, coolant temperature, vehicle speed and ambient temperature	Accumulated Time in "Monitor Run" Window < Threshold value base on Speed/Torque (Table A125) * Barometric Pressure modifier (Table A126) * Coolant Temperature modifier (Table A127) * Vehicle Speed modifier (Table A128)	Cold Start Emissions Reduction Warm up: Active SCR Mid Bed Temperature Sensor { Monitor Run Window} > 123.8°F (50.98°C) AND < 428°F (220°C) Ratio of total time in Monitor Run Window (defined above) to Engine Operation in Zone as defined by Speed/Torque as defined by [Table A129] > 0.9 Ratio of total time in Monitor Run Window (defined above) to Engine Operation in Coolant Temperature Range as defined by [Table A130] Barometric pressure ≥ 10.7 psi (73.5 kPa) AND ≤ 14.9 psi (103 kPa) KEY ON Limp Home Mode NOT active Time after exiting Limp Home Mode > 0

Fault Overview

Fault sets when Engine Control Module (ECM) monitors time for exhaust system to warm up, and time exceeds threshold. Threshold time is a function of engine operation, altitude, coolant temperature, vehicle speed and ambient temperature

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4377 (Ammonia)	• SPN 4380 (Ammonia)	• SPN 4382 (Ammonia)	

Fault Facts

Ambient Air Temperature (AAT) reading is used as reference in determining pass / fail for this fault. Moving vehicle from cold to warm ambient temperature may set this fault.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Aftermarket block heater installed

- Exhaust system leaks
- DOC restricted
- DPF restricted
- Low engine performance

Step 1	Check for low engine performance.	Decision
	Check for low engine performance. Does owner state engine has low performance?	Yes: See engine symptoms diagnostics.
		No: Go to Step 2.

Step 2	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1909). Is EST DTC list free of Associated Faults?	Yes: Go to Step 3.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 3061 FMI 31.

Step 3		Decision
	Inspect engine for aftermarket block or coolant heater. Is aftermarket block or coolant heater installed?	Yes: Disconnect block or coolant heater, retest for SPN 3061 FMI 31.
		No: Go to Step 4.

Step 4	Inspect exhaust system.	Decision
	Perform Exhaust and Aftertreatment System Inspection(page 2368). Is exhaust system free from leaks and physical damage?	Yes: Go to Step 5.
		No: Repair exhaust system. After repairs are complete, retest for SPN 3061 FMI 31.

Step 5	Check if regeneration is needed.	Decision
	Using EST with ServiceMaxx™ software, compare DPF soot load with DPF soot load regeneration threshold. Is DPF soot load above DPF soot load regeneration threshold?	Yes: Perform parked regeneration. After repairs are complete, retest for SPN 3061 FMI 31.
		No: Inspect DOC for restriction, replace as necessary. After repairs are complete, retest for SPN 3061 FMI 31.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 3061 FMI 31 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4364 FMI 18- Low NOx Conversion Detected

Condition / Description	Setting Criteria	Enable Conditions / Values
Aftertreatment system Nitrogen Oxides (NOx) conversion is less than expected.	Control system detects low NOx conversion rate in aftertreatment system	Exhaust Gas Recirculation (EGR) Off Engine Protection is not active Estimated Selective Catalyst Reduction (SCR) catalyst bed temperature between 356°F (180°C) to 842°F (450°C) Exhaust Flow rate 100 g/s to 440 g/s NOx In 100 ppm to 826 ppm NOx Out 0 ppm to 766 ppm Diesel Exhaust Fluid (DEF) injection rate > 0.07 ml/sec Ambient pressure (absolute) 12 psi (80 kPa) to 23 psi (160 kPa) Ambient Air Temperature (AAT) ≥ 19.9°F (-6.7°C) Rate of change of NOx In < 40 ppm/sec Rate of change of estimated SCR bed temperature ≤ 32.9°F/sec (0.5°C/sec) Rate of change of estimated exhaust mass flow < 10 g/sec SCR system NOx conversion efficiency is > -70%, urea deposit timer is < 150 hours, and DPFDP high error is not present for longer than 29 seconds Ammonia to NOx ratio is ≥ 0.01 for 5 seconds Timer to exit this enable condition is enabled if Ammonia to NOx ratio is < 0.01 for 3 seconds consecutively 0.1 < filtered ammonia to NOx ratio < 3 Inactive: SPN 3242 FMI 2, 3, and 4 (DPFIT); SPN 3480 FMI 2, 3, 4, and 17 (AFT: FP1); SPN 3482 FMI 2, 3, 4, and 7 (AFT: FEC); SPN 3610 FMI 2, 3, and 4 (DPFDP / outlet pressure sensor); SPN 4360 FMI 0 (SCRIT); SPN 4363 FMI 0 (SCROT); SPN 4765 FMI 2, 3, and 4 (DOCIT); SPN 4794 FMI 31

		(SCR); SPN 5742 FMI 3, 4, 11, and 12 (DOC / DPF temp sensor module)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxides (NOx) conversion efficiency of Selective Catalyst Reduction (SCR) catalyst is less than expected. Engine torque will be reduced if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3216 (NOx In)	• SPN 3218, SPN 3226 (NOx Out)	• SPN 3228 (NOx Out)	• SPN 3361 FMI 2, 3, and 4 (DEF: SP)
• SPN 3362 FMI 31 (DEF: SP)	• SPN 3363 FMI 3, 4, and 7 (DEF: THC)	• SPN 4334 FMI 2, 16 and 18 (DEF: AP)	• SPN 4340 FMI 3 and 5 (DEF: L3HC)
• SPN 4342 FMI 3 and 5 (DEF: L2HC)	• SPN 4344 FMI 3 and 5 (DEF: SMH)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)	• SPN 4363 FMI 2, 3, and 4 (SCROT)
• SPN 4377 (Ammonia)	• SPN 4380 (Ammonia)	• SPN 4382 (Ammonia)	• SPN 5394 FMI 5 and 7 (DEF: DU)
• SPN 5743 (SCR temp sensor module)	• SPN 520668 (AFT system)	• SPN 520669 (AFT system)	

Fault Facts

None

Drive Cycle to Determine Fault Status

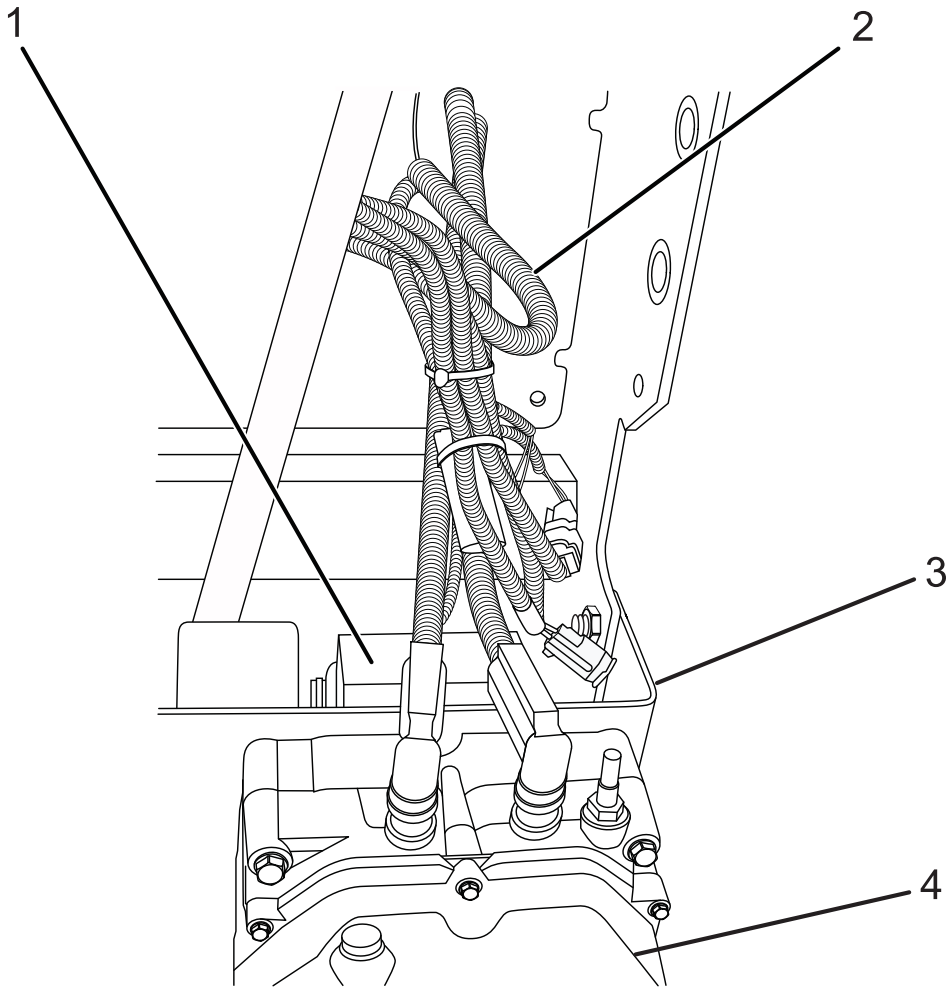
Continuous

Possible Causes

- Exhaust system leak(s)
- Diesel Exhaust Fluid (DEF) tank, supply module, or doser valve line or connection loose, leaking, damaged, or restricted
- Contaminated or degraded DEF
- Failed or Restricted Diesel Exhaust Fluid Dosing Unit (DEF: DU)
- Restricted DEF supply module filter
- DEF crystallization or deposits in exhaust piping
- Failed Selective Catalyst Reduction (SCR) Catalyst

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1914). Is EST DTC list free of Associated Faults?	Yes: Go to step 2.
		No: Associated Faults. After repairs are complete, retest for SPN 4364 FMI 18.

Step 2	Inspect Exhaust System.	Decision
	Inspect exhaust system for leaks and physical damage. Is the exhaust system free of leaks and physical damage?	Yes: Go to step 3.
		No: Repair leaks or physical damage. After repairs are complete, retest for SPN 4364 FMI 18.



0000041928

Figure 767 Diesel Exhaust Fluid (DEF) Supply Module Location

1. Power Distribution Module (PDM)
2. DEF lines
3. DEF tank bracket
4. DEF supply module

Step 3	Inspect Diesel Exhaust Fluid (DEF) lines and connections.	Decision
	Check DEF tank, DEF supply module, and DEF: DU lines and connections for: cracks and pitting; loose, leaking, or damaged connections; and restrictions. Are the DEF tank, DEF supply module, and DEF: DU lines and connections in good condition and unrestricted?	Yes: Go to step 4.
		No: Repair or replace failed line or connection. After repairs are complete, retest for SPN 4364 FMI 18.

Step 4	Check Diesel Exhaust Fluid (DEF) quality.	Decision
	Obtain a sample of DEF. Visually inspect for contamination and use DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 and 34% and not contaminated?	Yes: Go to step 5.
		No: Drain DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4364 FMI 18.

Step 5	Check decomposition tube for crystallization.	Decision
	Disconnect decomposition tube from exhaust system (see Exhaust System in *Engine Service Manual*) and inspect for Diesel Exhaust Fluid (DEF) crystallization. Is decomposition tube free of DEF crystallization?	Yes: Go to step 6.
		No: Remove DEF crystallization from decomposition tube. After repairs are complete, retest for SPN 4364 FMI 18.

Step 6	Verify correct Diesel Exhaust Fluid Dosing Unit (DEF: DU) operation.	Decision
	Using EST, perform (Key-On Engine-Off (KOEO) Diesel Exhaust Fluid (DEF) Doser Pump Override Test(page 2165). Is DEF: DU operating correctly?	Yes: Replace Selective Catalyst Reduction (SCR) catalyst. After repairs are complete, retest for SPN 4364 FMI 18.
		No: Perform DEF Supply Module Flush , using 18-200-01. If DEF: DU still does not operate correctly, replace DEF: DU. After repairs are complete, retest for SPN 4364 FMI 18.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4364 FMI 18 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4792 FMI 7 - SCR Catalyst System - Mechanical system not responding or out of adjustment

Condition / Description	Setting Criteria	Enable Conditions / Values
A malfunctioning Selective Catalyst Reduction (SCR) catalyst has been detected.	Nitrogen Oxides (NOx) conversion rate does not meet Aftertreatment Control Module (ACM) predetermined value	Key-On Engine-Running (KOER) Diesel Particulate Filter (DPF) Regeneration procedure running

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects that Nitrogen Oxides (NOx) conversion across Selective Catalyst Reduction (SCR) catalyst is lower than expected during one event, indicating a malfunctioning SCR catalyst.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4094 FMI 31 (contaminated or degraded DEF)	• SPN 4364 FMI 18 (low NOx conversion)	• SPN 4794 FMI 31 (missing SCR catalyst)	

Fault Facts

This fault code is only used to assist in troubleshooting fault codes SPN 4094 FMI 31 (AFT system), SPN 4364 FMI 18 (AFT system), and SPN 4794 FMI 31 (AFT system). One of these associated fault codes being active while SPN 4792 FMI 7 is active indicates the following conditions must be present: Diesel Exhaust Fluid (DEF) uncontaminated and in good condition; Properly functioning DEF dosing system (no leaks, restrictions, or failed components); No exhaust system leaks; Decomposition reactor tube free of DEF crystallization and deposits; Properly installed Selective Catalyst Reduction (SCR) catalyst.

Diagnostics for this fault code only runs during Electronic Service Tool (EST) Diesel Particulate Filter (DPF) Regeneration procedure.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) catalyst

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1919). Is EST DTC list free of Associated Faults?	Yes: Clear Associated Faults and retest for SPN 4792 FMI 7.
		No: Replace the Selective Catalyst Reduction (SCR) catalyst. After repairs are complete, retest for SPN 4792 FMI 7.

End Diagnostic Steps
After performing diagnostic step, if SPN 4792 FMI 7 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4792 FMI 14 - SCR Temperature Module (Incorrect Part)

Condition / Description	Setting Criteria	Enable Conditions / Values
Internal failure of the Selective Catalyst Reduction (SCR) temperature sensor module has been detected.	Aftertreatment Control Module (ACM) detects an internal circuit failure of SCR temperature sensor module	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects an internal circuit error in Selective Catalytic Reduction (SCR) temperature sensor module, or wrong SCR temperature sensor module installed, after two events. Active and parked regeneration of aftertreatment system is disabled, and Exhaust Gas Recirculation (EGR) valve is closed.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Step 1	Check for active or pending fault codes	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4792 FMI 14. Is EST DTC list SPN XX FMI X active or pending?	Replace Selective Catalyst Reduction (SCR) temperature sensor module. After repairs are complete, retest for SPN 4792 FMI 14.

End Diagnostic Steps
After performing diagnostic step, if SPN 4792 FMI 14 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4794 FMI 31 - SCR Catalyst System Missing

Condition / Description	Setting Criteria	Enable Conditions / Values
The Selective Catalyst Reduction (SCR) catalyst has low Nitrogen Oxides (NOx) conversion.	SCR catalyst conversion efficiency < 10%	Exhaust Gas Recirculation (EGR) off, Engine Protection is not active Estimated SCR catalyst bed temperature between 464°F (240°C) to 716°F (380°C) Exhaust Flow rate 125 g/s to 400 g/s NOx In 61 ppm to 840 ppm NOx Out 0 ppm to 840 ppm DEF injection rate > 0.03 ml/sec Ambient pressure (absolute) 10 psi (70 kPa) to 14.5 psi (100 kPa) Ambient air temperature ≥ 19.9°F (-6.7°C) Rate of change of NOx In < 10 ppm/sec Rate of change of estimated SCR bed temperature ≤ 32.9°F (0.5°C) /sec Rate of change of estimated exhaust mass flow < 0.5 g/sec Inactive: SPN 4363 FMI 0 (SCROT)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Nitrogen Oxides (NOx) conversion efficiency of Selective Catalyst Reduction (SCR) catalyst is critically low for 7 seconds. ACM compares Nitrogen Oxides Intake Concentration (NOx In) sensor value, to Nitrogen Oxides Outlet Concentration (NOx Out) sensor value. Engine torque will be reduced if fault is active for a limited period of time. Engine torque will be severely reduced and vehicle speed limited if fault is active for an extended period of time.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3226 (NOx Out)	• SPN 3228 (NOx Out)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)	• SPN 4363 FMI 0, 2, 3, and 4 (SCROT)

Fault Facts

None

Drive Cycle to Determine Fault Status

Road Test

Possible Causes

- Missing Selective Catalyst Reduction (SCR) catalyst
- Contaminated, damaged, or cracked SCR Catalyst
- Contaminated Diesel Exhaust Fluid (DEF)
- Failed DEF Dosing Unit (DEF: DU)

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Fault(page 1923).		Yes: Go to Step 2.
Is EST DTC list free of Associated Fault?		No: Repair Associated Fault. After repairs are complete, retest for SPN 4794 FMI 31.

Step 2	Check exhaust system.	Decision
Check exhaust system for an installed Selective Catalyst Reduction (SCR) catalyst.		Yes: Go to Step 3.
Is an SCR catalyst installed in the exhaust system?		No: Install proper SCR. After repairs are complete, retest for SPN 4794 FMI 31.

Step 3	Check Diesel Exhaust Fluid (DEF) quality.	Decision
A. Obtain a sample of DEF. B. Visually inspect for contamination. C. Use DEF Refractometer 5025 to test urea concentration of DEF fluid.		Yes: Go to Step 4.
Is urea concentration between 30 and 34% and not contaminated?		No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4794 FMI 31.

Step 4	Check exhaust system.	Decision
Perform Key-On Engine-Off (KOEO) Supply Pump Override Test (page 2165).		Yes: Retest for SPN 4794 FMI 31.
Does DEF Dosing Unit (DEF: DU) inject 100 ml of DEF?		No: Replace DEF: DU. After repairs are complete, retest for SPN 4794 FMI 31.

End Diagnostic Steps
After performing diagnostic step, if SPN 4794 FMI 31 remains, verify if step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5743 FMI 3 - SCR Thermocouple Controller Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Selective Catalyst Reduction (SCR) temperature sensor module has detected high supply voltage.	SCR temperature sensor module supply voltage > 17 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction (SCR) temperature sensor module supply voltage is high for a period of 4.2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 609 FMI 3 (ACM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module
- Incorrect battery wiring (series instead of in parallel)
- Charging voltage is excessive

Step 1	Check for associated fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1926). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 5743 FMI 3.

Step 2	Inspect connections at Selective Catalyst Reduction (SCR) temperature sensor module.	Decision
	A. Key OFF. B. Disconnect SCR sensor module connector. C. Check SCR sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are SCR sensor connector, harness, and terminal clean and undamaged?	Yes: Perform Pin-Point Tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5743 FMI 3.

Pin-Point Tests (SPN 5743 FMI 3)

SCR Temp. Sensor Module Circuit

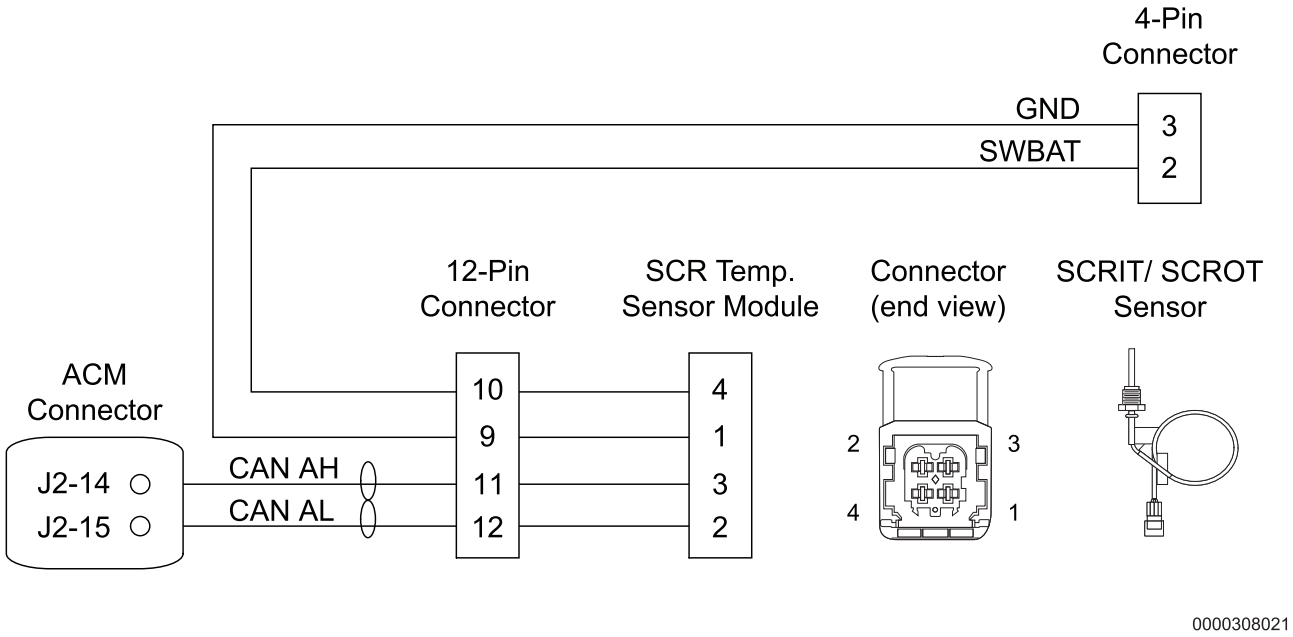


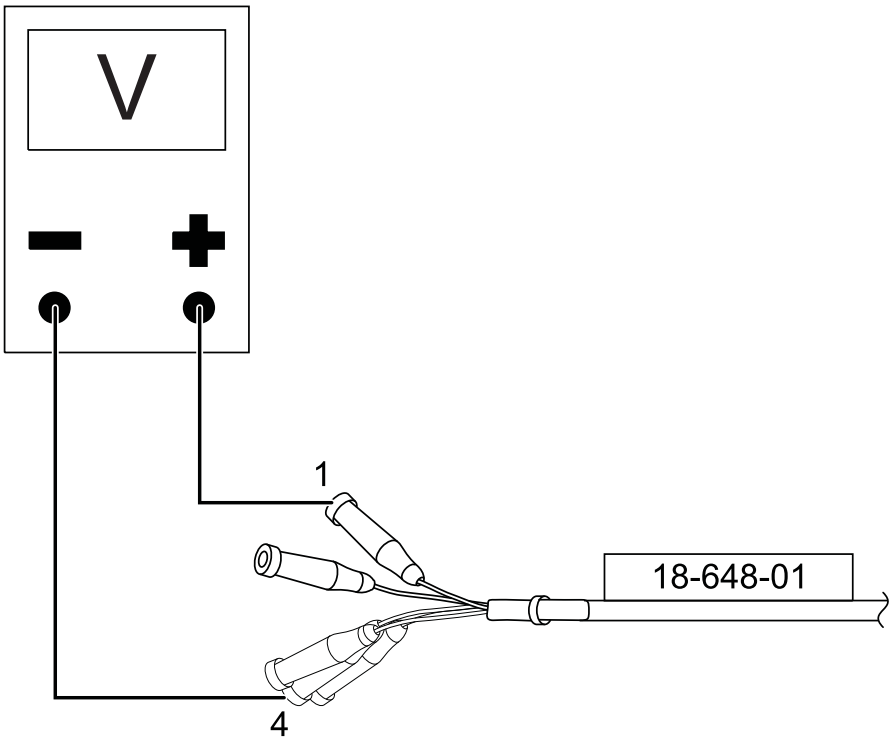
Figure 768 Selective Catalyst Reduction (SCR) Temperature Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Verify charging system is charging at specified voltage.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)



0000308508

Figure 769 Test 1 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Selective Catalyst Reduction (SCR) temperature sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between breakout harness 18-648-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 5743 FMI 3.
	No: Repair incorrect battery wiring. After repairs are complete, retest for SPN 5743 FMI 3

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5743 FMI 3 fault code diagnostics.

SPN 5743 FMI 4 - SCR Thermocouple Controller Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module has detected low supply voltage.	SCR temperature sensor module supply voltage < 6.3 ± 0.3 volts	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction (SCR) temperature sensor module supply voltage is low for a period of 4.2 seconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 609 FMI 3 (ACM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module
- GND circuit intermittent Open or high resistance
- SWBAT circuit intermittent short to ground or Open

Step 1	Check for associated fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1930). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 5743 FMI 4.

Step 2	Inspect connections at Selective Catalyst Reduction (SCR) temperature sensor module.	Decision
	A. Key OFF. B. Disconnect SCR sensor module connector. C. Check SCR sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are SCR sensor connector, harness, and terminal clean and undamaged?	Yes: Perform Pin-Point Tests.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5743 FMI 4.

Pin-Point Tests (SPN 5743 FMI 4)

SCR Temp. Sensor Module Circuit

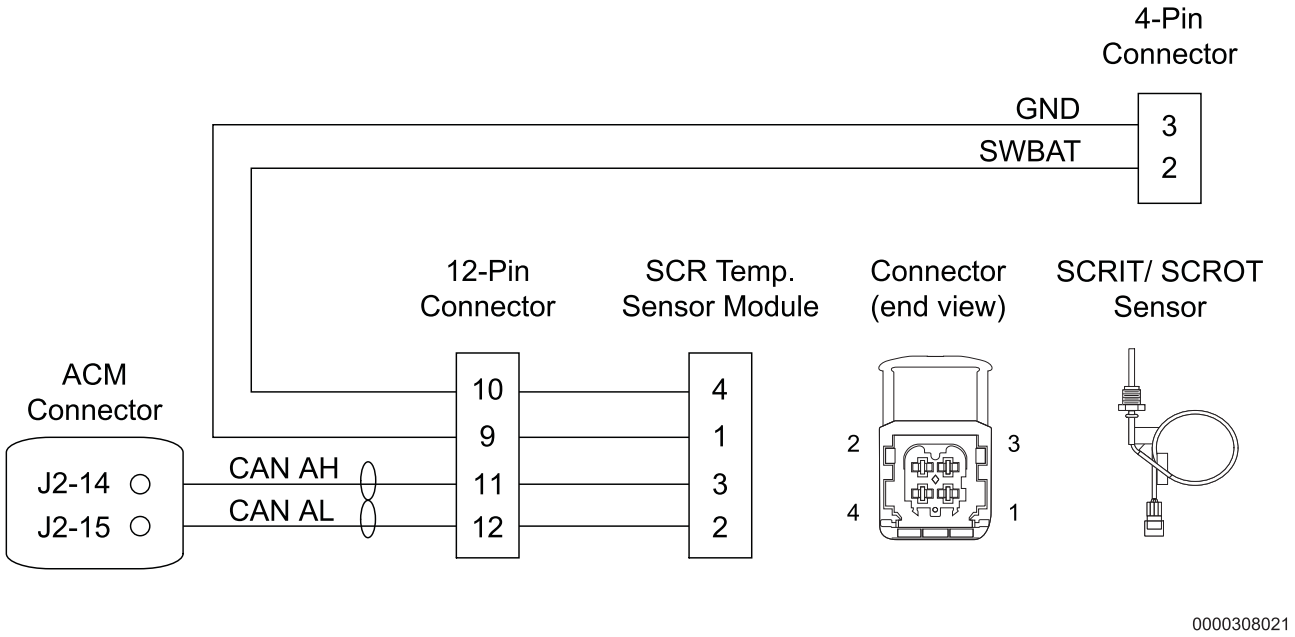


Figure 770 Selective Catalyst Reduction (SCR) Temperature Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)

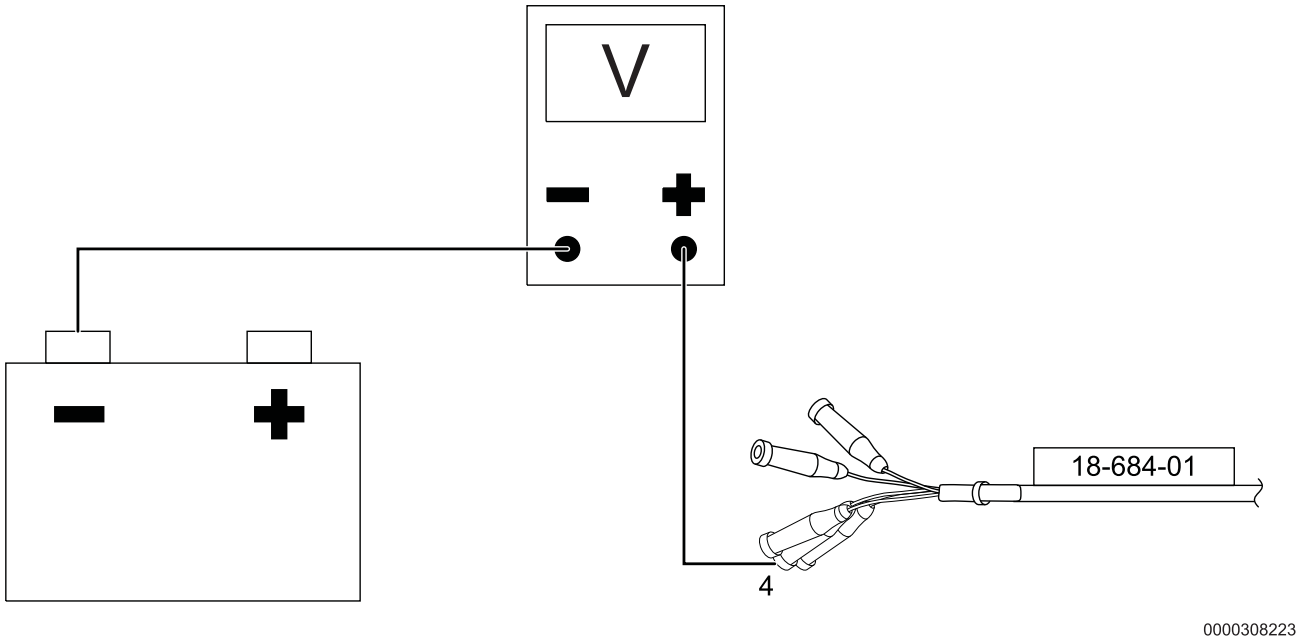


Figure 771 Test 1 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-684-01 to Selective Catalyst Reduction (SCR) temperature sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-684-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 5743 FMI 4.
	No: Go to Test 2.

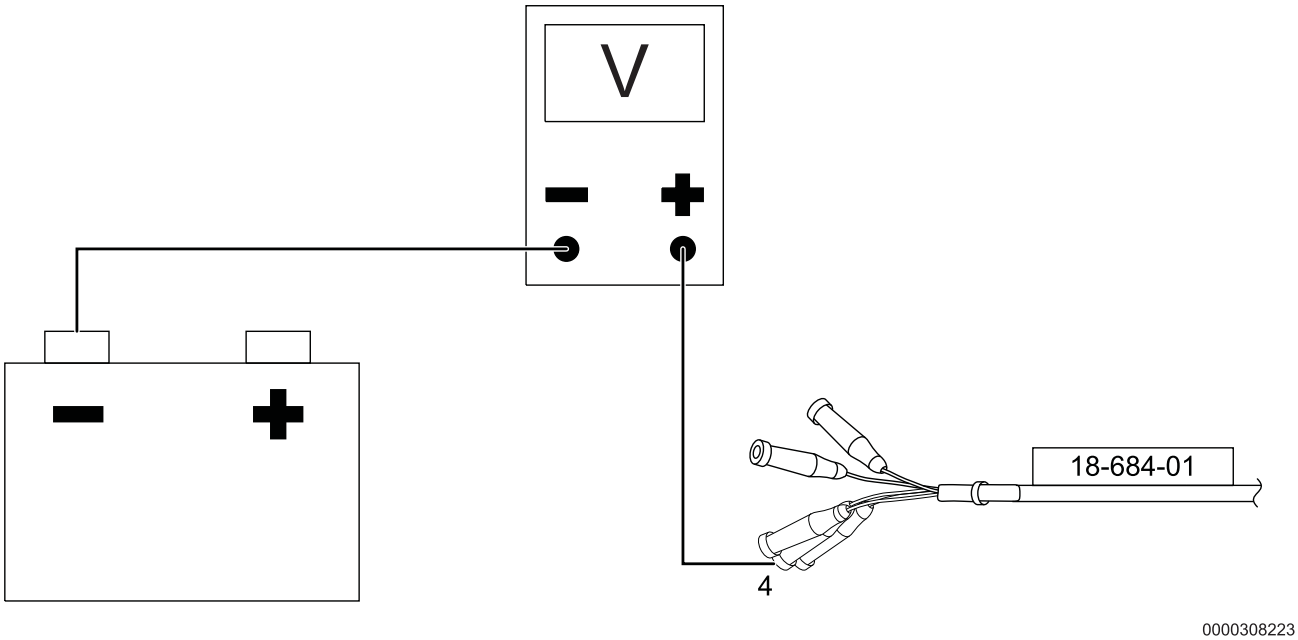


Figure 772 Test 2 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-684-01 to Selective Catalyst Reduction (SCR) temperature sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-684-01 pin-4 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair Open or high resistance between SCR temperature sensor module connector pin-1 and ground. After repairs are complete, retest for SPN 5743 FMI 4.
	No: Repair Open or short to ground between SCR temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5743 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5743 FMI 4 fault code diagnostics.

SPN 5743 FMI 11 - SCR Thermocouple Controller signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module has detected an intermittent power supply voltage drop that results in a reset internal to the module.	Number of SCR temperature sensor module power reset events within a 300 second window is ≥ 5 counts	Key ON Time after Key ON ≥ 5 seconds

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects number of Selective Catalyst Reduction (SCR) temperature sensor module power reset events within a 300 second window is ≥ 5 counts. Active and parked regeneration is disabled. Exhaust Gas Recirculation (EGR) valve operation will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN's 168 FMI 16 and 18 (ACM)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing, damaged, or restricted air flow across Selective Catalyst Reduction (SCR) temperature sensor module
- SWBAT circuit intermittent open or short to ground
- Ground circuit intermittent open or short to power
- Failed SCR temperature sensor module

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1935). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 5743 FMI 11.

Step 2	Inspect for damaged or missing Selective Catalyst Reduction (SCR) temperature sensor module heat shield.	Decision
	Check for air flow restrictions around SCR temperature sensor module (mud, aftermarket shields, flaps, or brackets installed). Is SCR temperature sensor module heat shield free of air restrictions and is not missing or damaged?	Yes: Go to Step 3. No: Remove air restriction, or replace or repair SCR temperature sensor module heat shield. After repairs are complete, retest for SPN 5743 FMI 11.

Step 3	Inspect connections at Selective Catalyst Reduction (SCR) temperature sensor module.	Decision
	A. Key OFF. B. Disconnect SCR temperature sensor module connector. C. Check SCR temperature sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are SCR temperature sensor connector, harness, and terminal clean and undamaged?	Yes: Perform Pin-Point Tests(page 1937). No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 5743 FMI 11.

Pin-Point Tests (SPN 5743 FMI 11)

Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit

SCR Temp. Sensor Module Circuit

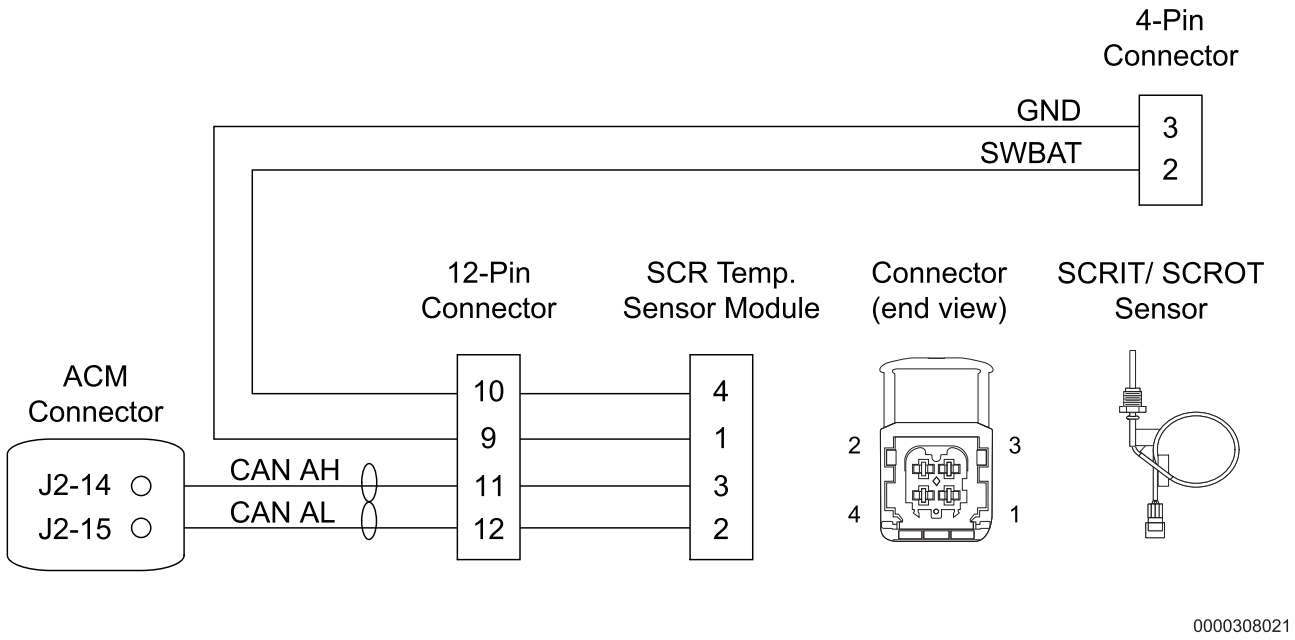


Figure 773 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)

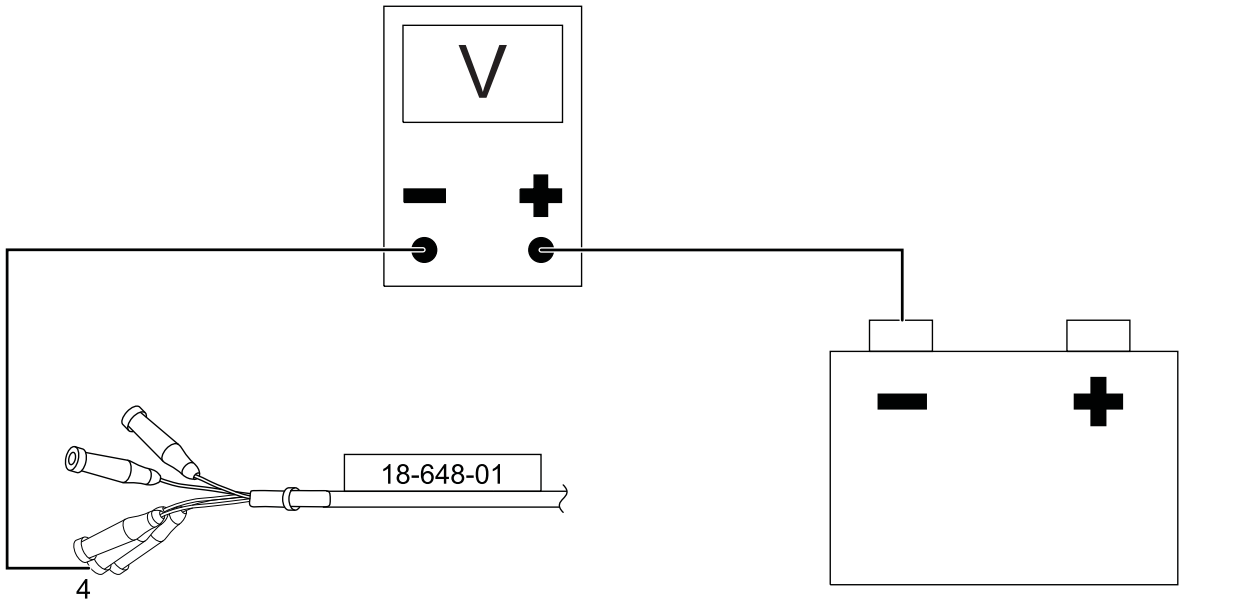
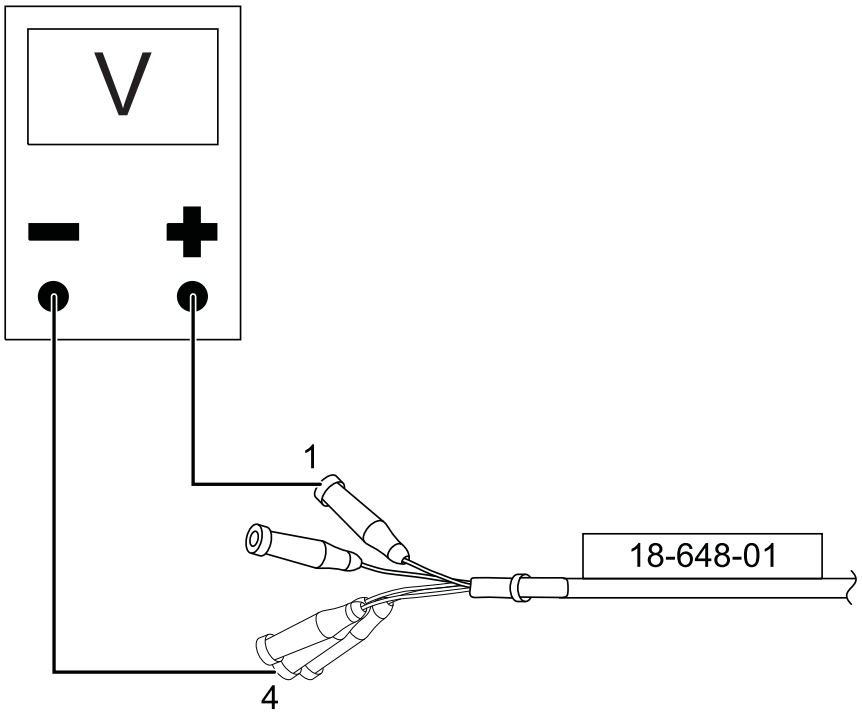


Figure 774 Test 1 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Selective Catalyst Reduction (SCR) temperature sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-4 and known good ground (wiggle if necessary).	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 2.
	No: Repair intermittent, open or short to ground in between Selective Catalyst Reduction (SCR) temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, retest for SPN 5743 FMI 11.



0000308742

Figure 775 Test 2 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 to Selective Catalyst Reduction (SCR) temperature sensor module vehicle harness connector and leave sensor module disconnected. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and pin-4 (wiggle if necessary).	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 5743 FMI 11.
	No: Repair intermittent open or short to power between SCR temperature sensor module connector pin-1 and ground. After repairs are complete, retest for SPN 5743 FMI 11.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5743 FMI 11 fault code diagnostics.

SPN 5743 FMI 16 - SCR Thermocouple Controller above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module has detected internal temperature too high.	SCR temperature sensor module > 302°F (150°C)	Key-ON Engine-Running (KOER)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction (SCR) temperature sensor module is greater than 302°F (150°C) for 3.8 seconds. Active and parked regeneration is disabled. Exhaust Gas Recirculation (EGR) valve operation will be disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4360 FMI 0, 16 (SCRIT)	• SPN 4363 FMI 0, (SCROT)		

Fault Facts

This fault will go inactive after Selective Catalyst Reduction (SCR) temperature sensor module temperature drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes. Inspect for overheated aftertreatment components, cracked exhaust system welds, leaking exhaust system seams, or other damage.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Missing, damaged, or restricted air flow across Selective Catalyst Reduction (SCR) temperature sensor module
- Exhaust leak(s)
- Failed SCR temperature sensor module

Step 1	Check for associated fault codes.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1941). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 5743 FMI 16.

Step 2	Inspect for damaged or missing Selective Catalyst Reduction (SCR) temperature sensor module mounting.	Decision
	Check for proper mounting of the SCR temperature sensor module. Also, check for air flow restrictions surrounding the sensor module. Is SCR temperature sensor module mounted properly and free of air restrictions?	Yes: Go to Step 3.
		No: Remove air restriction and ensure module is mounted properly. After repairs are complete, retest for SPN 5743 FMI 16.

Step 3	Inspect exhaust system.	Decision
	Inspect exhaust system for leaks and physical damage. Is exhaust system free of leaks and physical damage?	Yes: Replace Selective Catalyst Reduction (SCR) temperature sensor module. After repairs are complete, retest for SPN 5743 FMI 16.
		No: Repair or replace leaking or damaged exhaust components. Refer to Fault Facts. After repairs are complete, retest for SPN 5743 FMI 16.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 5743 FMI 16 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 5743 FMI 19 - SCR Temperature module not detect J1939

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module not detected on J1939 Controller Area Network (CAN).	Aftertreatment Control Module (ACM) loses J1939 data link communications with SCR temperature sensor module.	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) loses J1939 Controller Area Network (CAN) data link communications with Selective Catalyst Reduction (SCR) temperature sensor module during two events.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

If more than one of following sensor modules fail (or set a fault), suspect common power circuit, ground circuit, or switched ignition relay problem. Following components share power and ground circuits: DOC / DPF temperature sensor module, SCR temperature sensor module, NH3 sensor module, NOx Out sensor module, NOx In sensor module, and DEF: TL and DEF: TT sensor module.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Switched battery circuit short to ground or open
- CAN-AH circuit open or short to ground
- CAN-AL circuit open or short to ground
- CAN-AH circuit short to power
- CAN-AL circuit short to power
- Ground circuit open or high resistance
- CAN-AH short to CAN-AL
- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Verify batteries are fully charged and connections are clean.

Step 1	Check for active fault code.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 5743 FMI 19. Does EST DTC list show SPN 5743 FMI 19 as active?	Yes: Go to Step 2. No: Drive vehicle and retest for SPN 5743 FMI 19. If fault code does not return, notify supervisor for further action.

Step 2	Inspect connections at Selective Catalyst Reduction (SCR) temperature sensor module.	Decision
	A. Key OFF. B. Disconnect SCR temperature sensor module connector. C. Check SCR temperature sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are SCR temperature sensor connector, harness, and terminal clean and undamaged?	Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

Pin-Point Tests (SPN 5743 FMI 19)

SCR Temp. Sensor Module Circuit

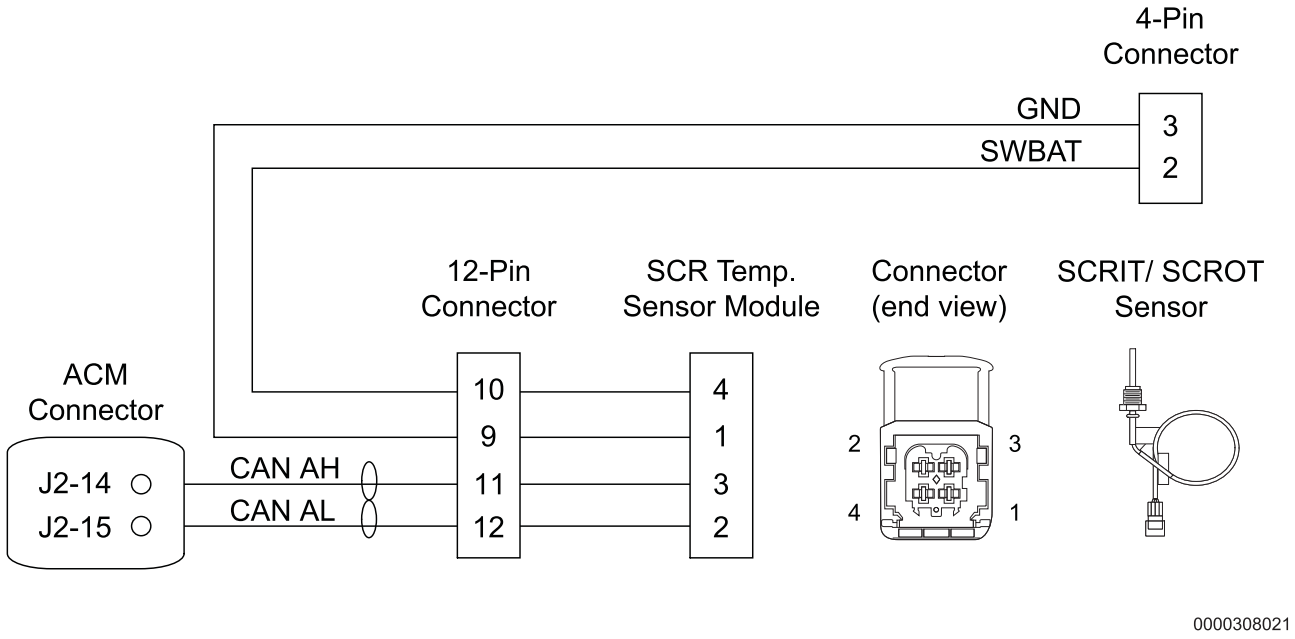
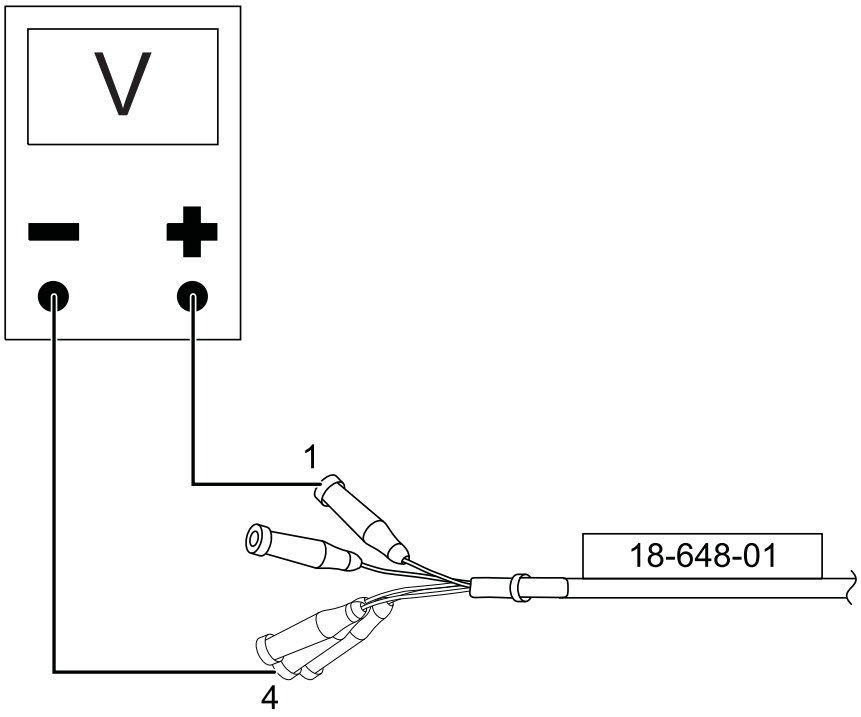


Figure 776 Selective Catalyst Reduction (SCR) Temperature Sensor Circuit Diagram

See latest version of Navistar® Engine N9 and N10 and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness 18-648-01
- Digital Multimeter (DMM)



0000308742

Figure 777 Test 1 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-1 and pin-4.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Go to Test 3.
	No: Go to Test 2.

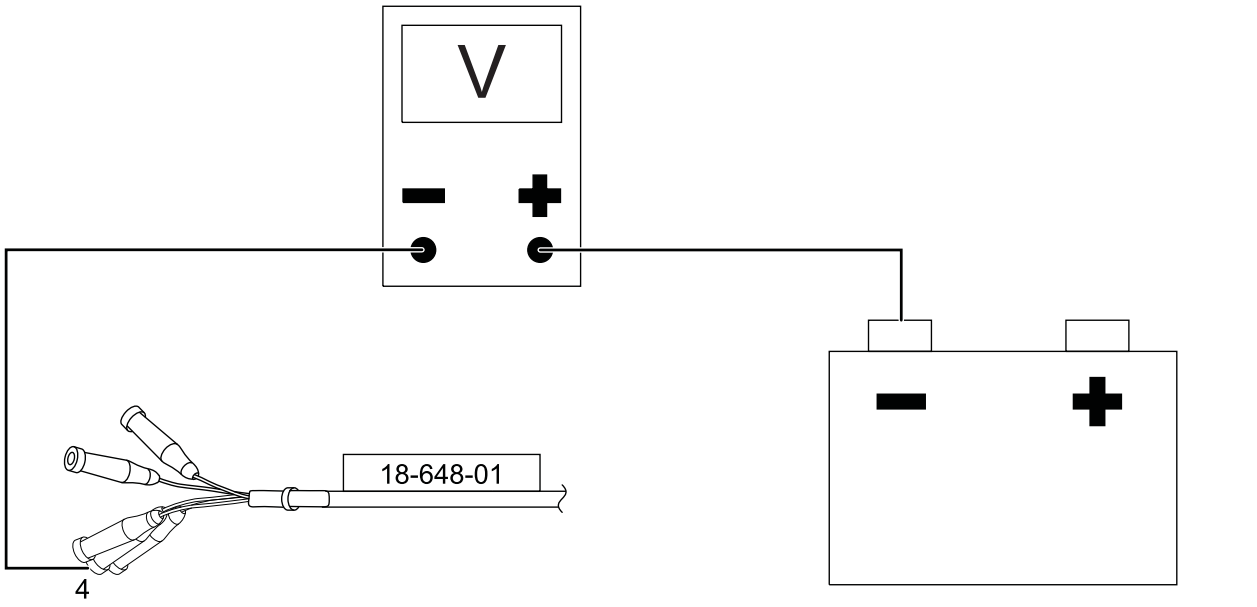


Figure 778 Test 2 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-4 and known good ground.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair open or high resistance between Selective Catalyst Reduction (SCR) temperature sensor module pin-1 and ground. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.
	No: Repair open or short to ground between SCR temperature sensor module connector pin-4 and switched ignition relay pin-87. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

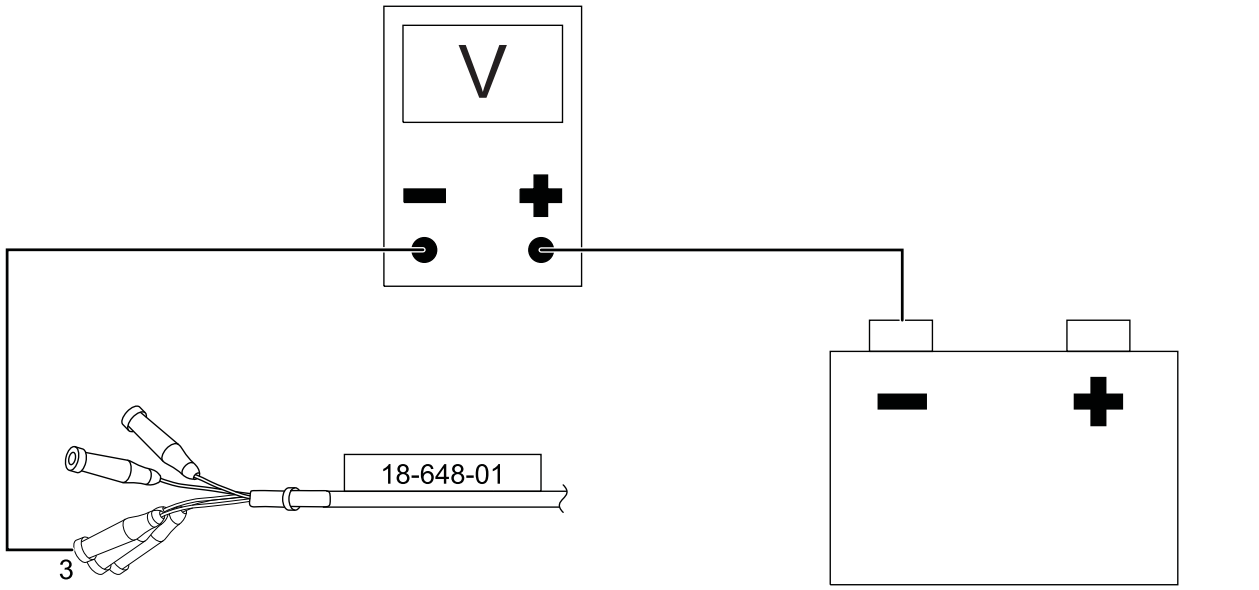


Figure 779 Test 3 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-3 and known good ground.	1 to 4 volts
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 4.
	No: Repair open or short to ground between Selective Catalyst Reduction (SCR) temperature sensor module connector pin-3 and Aftertreatment Control Module (ACM) connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

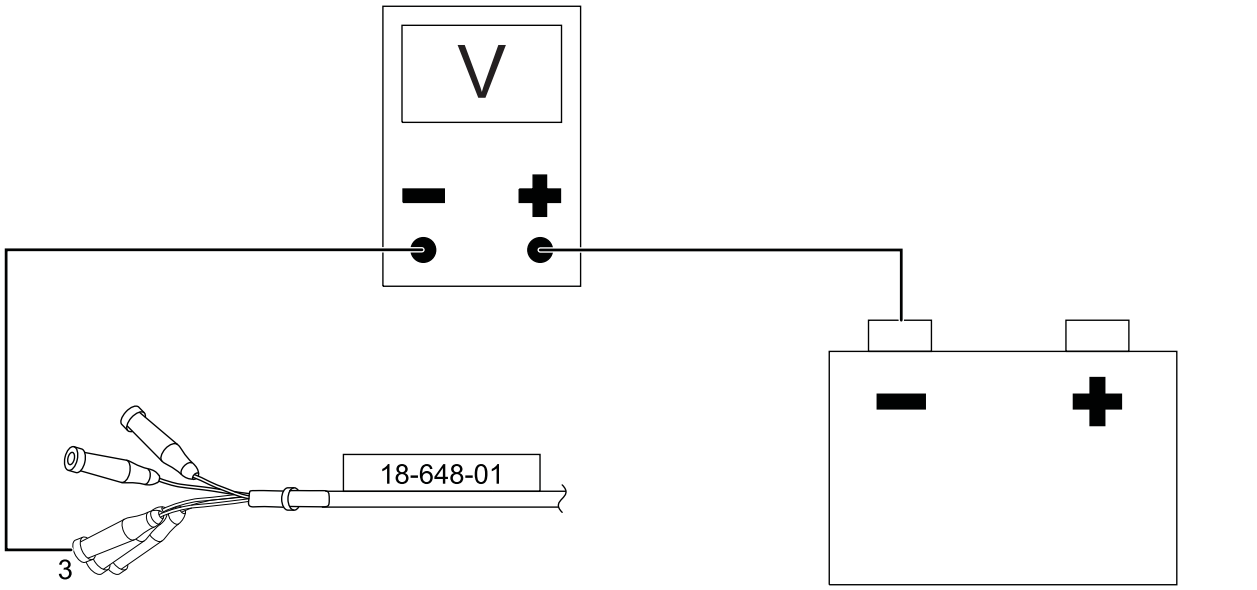


Figure 780 Test 4 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 4	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-3 and known good ground.	1 to 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 5.
	No: Repair short to power between Selective Catalyst Reduction (SCR) temperature sensor module connector pin-3 and Aftertreatment Control Module (ACM) connector J2-14. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

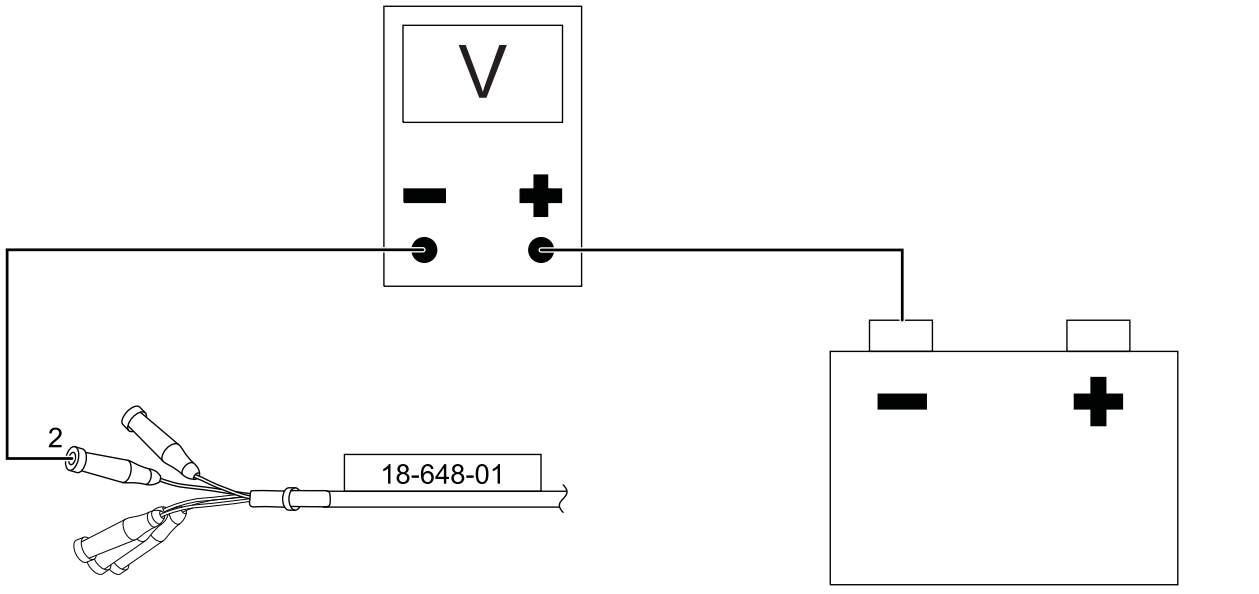


Figure 781 Test 5 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 5	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-2 and known good ground.	1 to 4 volts
Decision	
Is voltage greater than 1 volt?	Yes: Go to Test 6.
	No: Repair open or short to ground between Selective Catalyst Reduction (SCR) temperature sensor module connector pin-2 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

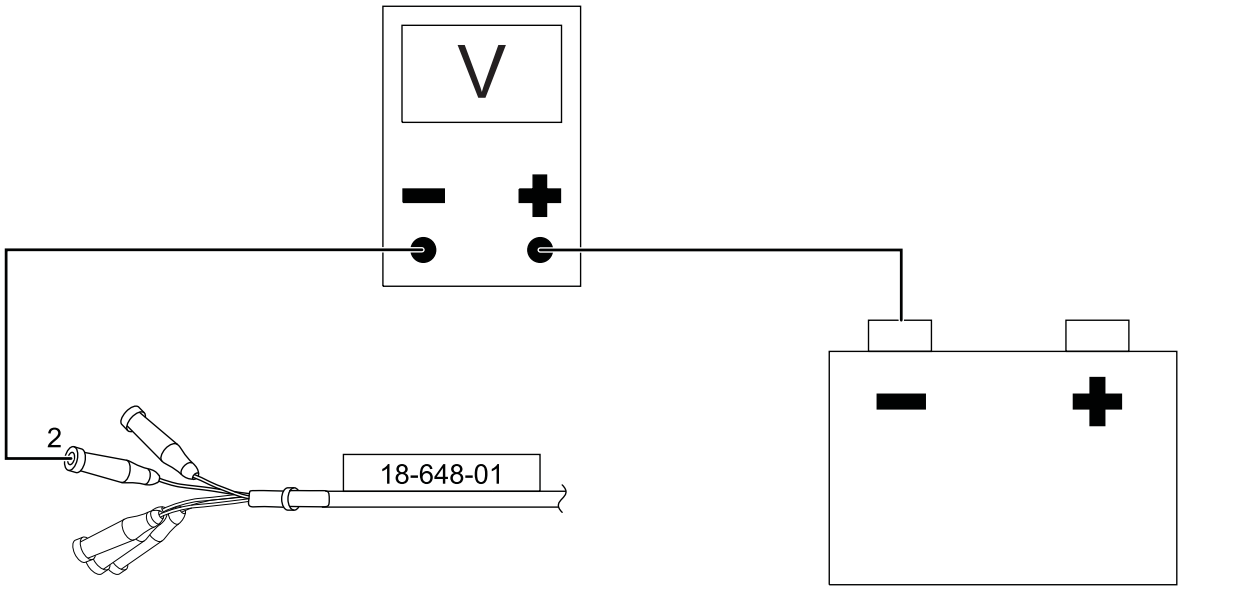
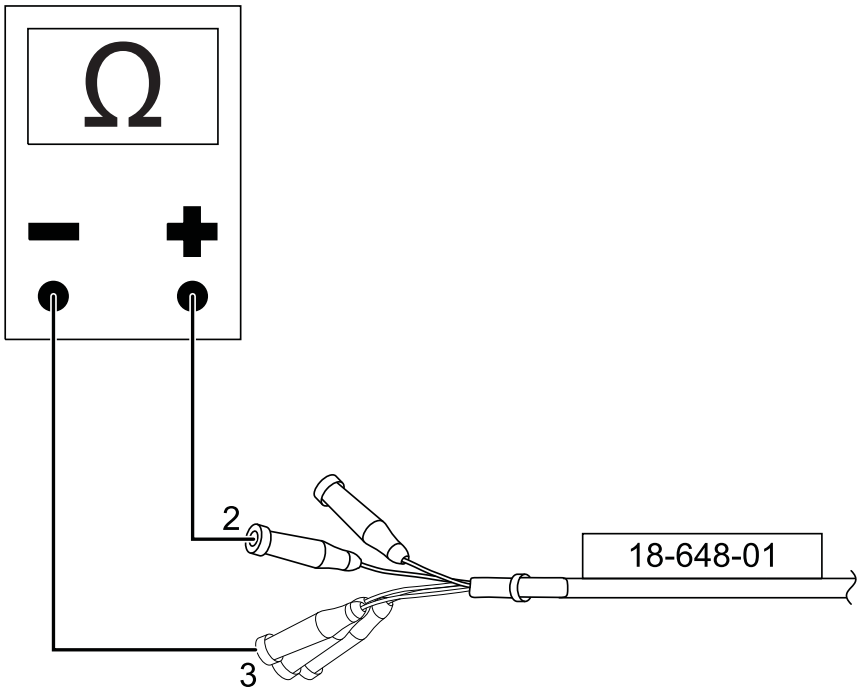


Figure 782 Test 6 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 6	Specification
Use DMM to measure voltage between Breakout Harness 18-648-01 pin-2 and known good ground.	1 to 4 volts
Decision	
Is voltage less than 4 volts?	Yes: Go to Test 7.
	No: Repair short to power between Selective Catalyst Reduction (SCR) temperature sensor module connector pin-2 and ACM connector J2-15. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.



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Figure 783 Test 7 Selective Catalyst Reduction (SCR) Temperature Sensor Module Circuit Resistance Check

Test 7 Setup
A. Key OFF. B. Connect Breakout Harness 18-648-01 between Selective Catalyst Reduction (SCR) temperature sensor module and vehicle harness connector. C. Key ON.

Test 7	Specification
Use DMM to measure resistance between Breakout Harness 18-648-01 pin-2 and pin-3.	Approximately 60 ohms
Decision	
Is resistance greater than 50 ohms?	Yes: Replace Selective Catalyst Reduction (SCR) temperature sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.
	No: Repair short between SCR temperature sensor module connector pin-2 and pin-3. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 5743 FMI 19.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 5743 FMI 19 fault code diagnostics.

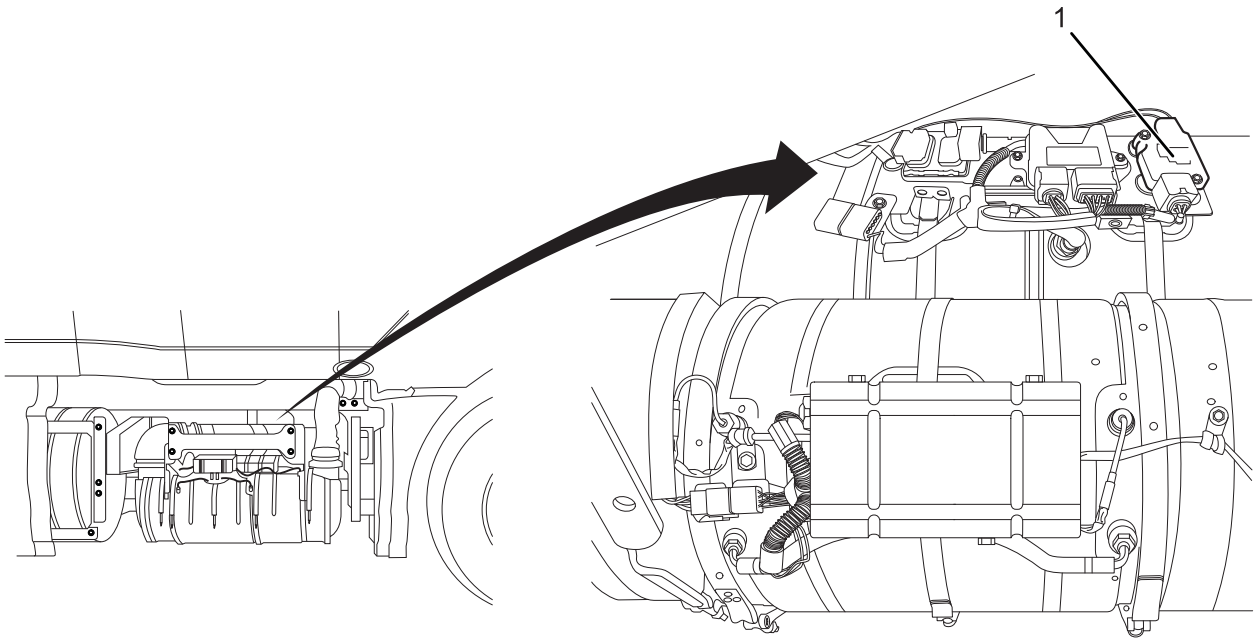
SCRIT (Selective Catalyst Reduction Intake Temperature) Sensor

Overview of SCRIT Sensor Group

SPN	FMI	Description
4360	0	SCRIT above Critical Temperature (page 1955)
4360	2	SCRIT signal erratic, intermittent or incorrect (page 1958)
4360	3	SCRIT signal Out of Range HIGH (page 1961)
4360	4	SCRIT signal Out of Range LOW (page 1963)
4360	16	SCRIT above Maximum Temperature (page 1965)

Overview

Selective Catalyst Reduction Intake Temperature (SCRIT) sensor measures exhaust temperature at intake of Selective Catalyst Reduction (SCR) catalyst. SCR temperature sensor module is a smart device that communicates with Aftertreatment Control Module (ACM) via Controller Area Network (CAN). SCRIT sensor is part of SCR temperature sensor module, and is not serviceable individually.



0000055023

Figure 784 Selective Catalyst Reduction Intake Temperature (SCRIT) Sensor Module Location

1. SCR temperature sensor module

SPN 4360 FMI 0 - SCRIT above Critical Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction Intake Temperature (SCRIT) continuously above a severe, high threshold.	SCRIT > 1472°F (800 °C)	Key-On Engine-Running (KOER) Inactive: SPN 4360 FMI 2, 3, and 4 (SCRIT); and SPN 5743 FMI 3, 4 and 11 (SCR).

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction Intake Temperature (SCRIT) sensor reading is greater than 1472°F (800°C) for more than 20 seconds. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled and engine can possibly be shut down.

Lamp Reaction

Malfunction Indicator Lam (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL) • SPN 4765 FMI 0, 15, and 16 (DOCIT)	• SPN 3242 FMI 0, 15, and 16 (DPFIT) • SPN 5743 FMI 3, 4, 11, and 16 (SCR)	• SPN 3246 FMI 0, 15, and 16 (DPFOT)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)

Fault Facts

This fault will go inactive after SCRIT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Selective Catalyst Reduction (SCR) temperature sensor module
- Contaminated Diesel Exhaust Fluid (DEF)

Step 1	Check for associated faults.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1955). Is EST DTC list free of Associated Faults?	Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4360 FMI 0.

Step 2	Check Diesel Exhaust Fluid (DEF) quality.	Decision
	Obtain a sample of DEF. Visually inspect for contamination, and use special tool DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 and 34 percent and Not contaminated?	Yes: Go to Step 3. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4360 FMI 0.

Step 3	Check for failed Selective Catalytic Reduction (SCR) temperature sensor module.	Decision
	Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is SCRIT and SCROT difference within 77°F (43°C) of each other?	Yes: Go to Step 4. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4360 FMI 0.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
	Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?	Yes: Go to step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4360 FMI 0.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?	Yes: Go to Step 6.
		No: Replace AFT: FEC. After repairs are complete, retest for SPN 4360 FMI 0.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
	Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?	Yes: Go to Step 7.
		No: Replace AFT: FPC. After repairs are complete, retest for SPN 4360 FMI 0.

Step 7	Check for restricted exhaust.	Decision
	Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?	Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4360 FMI 0.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 4360 FMI 0.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4360 FMI 0 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4360 FMI 2- SCRIT signal erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Selective Catalytic Reduction Intake Temperature (SCRIT) is not changing with engine operating conditions (in-range but not rational).	Average temperature difference across SCR > 162°F (90°C) OR average temperature difference across SCR < -162°F (-90°C) SCRIT < 374°F (190°C) OR SCR Outlet Temperature (SCROT) < 392°F (200°C)	Ambient Air Temperature ≥ -68°F (-20°C) Engine coolant temperature > 140°F (60°C) [302°F (150°C) < SCRIT < (600°C) OR 302°F (150°C) < SCROT < 302°F (600°C)] Barometric Pressure (BARO) ≥ 75 kPa (gauge) Engine Speed > 200 RPM for 600 seconds Engine Speed > 800 RPM for 300 seconds Elapsed time since last active regeneration > 1,200 sec 250 g/sec < Exhaust flow < 1,000 g/sec Inactive: SPN 3246 FMI 3 and 4 (DPFOT); SPN 4360 FMI 3, 4 (SCRIT); SPN 4363 FMI 3, 4 (SCROT); SPN 5742 FMI 3, 4, and 11 (DPF); SPN 5743 FMI 3, 4, and 11 (SCR)

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) has determined Selective Catalytic Reduction Intake Temperature (SCRIT) sensor does not match engine operating conditions for more than 5 minutes. Diesel exhaust fluid (DEF) injection into aftertreatment system is disabled, and engine torque will be reduced if the engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 3246 FMI 3 and 4 (DPFOT) • SPN 5743 FMI 3, 4, 11, and 16 (SCR)	• SPN 4360 FMI 3 and 4 (SCRIT)	• SPN 4363 FMI 3 and 4 (SCROT)	• SPN 5742 FMI 3, 4, and 11 (DPF)

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalytic Reduction (SCR) temperature sensor module

Step 1	Check for associated faults.	Decision
	Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code list for Associated Faults(page 1958). Is EST DTC list free of Associated Faults?	Yes: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4360 FMI 3.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4360 FMI 3.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4360 FMI 2 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4360 FMI 3 - SCRIT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module is shorted to battery or open circuit in Selective Catalyst Reduction Intake Temperature (SCRIT) sensor circuit.	SCRIT sensor module supply voltage ≥ 5 volts or SCRIT sensor thermocouple impedance ≥ 10 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction Intake Temperature (SCRIT) sensor circuit is shorted to battery or Open for a period of 16 seconds. Active and parked regeneration will be disabled, and engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

SPN 5743 FMI 3, 4, 11, 16 and 19 (SCR)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Step 1	Check for associated fault code.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1961). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4360 FMI 3.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4360 FMI 3 (SCRIT). Is EST DTC list SPN 4360 FMI 3 active or pending?		Yes: Replace SCR temperature sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4360 FMI 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4360 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4360 FMI 4 - SCRIT Signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) temperature sensor module is shorted to ground in the Selective Catalyst Reduction Intake Temperature (SCRIT) sensor circuit.	SCRIT temperature sensor module supply voltage ≤ 1 volt	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction Intake Temperature (SCRIT) sensor signal voltage is less than 1 volt for a period of 16 seconds. Active and parked regeneration will be disabled and engine torque reduced if the engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5743 FMI 3, 4, 11, and 16 (SCR)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 1963). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4360 FMI 4.

Step 2	Check for active fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 4360 FMI 4 (SCRIT). Does EST DTC list show SPN 4360 FMI 4 as active or pending?		Yes: Replace SCR temperature sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4360 FMI 4.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4360 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4360 FMI 16 - SCRIT above Maximum Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Selective Catalyst Reduction (SCR) Intake Temperature (SCRIT) continuously above a maximum temperature.	SCRIT > 1472°F (800°C)	Inactive: SPN 4360 FMI 2, 3, and 4 (SCRIT); SPN 5743 FMI 3, 4 and 11 (SCR).

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction (SCR) Intake Temperature (SCRIT) reading is greater than 1472°F (800°C) for more than 20 seconds. Engine may shut down and Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL) • SPN 4765 FMI 0, 15, and 16 (DOCIT)	• SPN 3242 FMI 0, 15, and 16 (DPFIT) • SPN 5743 FMI 3, 4, 11, and 16 (SCR)	• SPN 3246 FMI 0, 15, and 16 (DPFOT)	• SPN 4360 FMI 2, 3, and 4 (SCRIT)

Fault Fact

This fault will go inactive after SCRIT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Selective Catalyst Reduction (SCR) temperature sensor module
- Contaminated Diesel Exhaust Fluid (DEF)

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1965). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4360 FMI 16.

Step 2	Check Diesel Exhaust Fluid (DEF) quality.	Decision
Obtain a sample of DEF. Visually inspect for contamination, and use special tool DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 and 34 percent and Not contaminated?		Yes: Go to Step 3. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4360 FMI 16.

Step 3	Check for failed Selective Catalytic Reduction (SCR) temperature sensor module.	Decision
Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is SCRIT and SCROT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4360 FMI 16.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4360 FMI 16.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?		Yes: Go to Step 6.
		No: Replace AFT: FEC. After repairs are complete, retest for SPN 4360 FMI 16.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7.
		No: Replace AFT: FPC. After repairs are complete, retest for SPN 4360 FMI 16.

Step 7	Check for restricted exhaust.	Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4360 FMI 16.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 4360 FMI 16.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4360 FMI 16 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SCROT (Selective Catalyst Reduction Outlet Temperature) Sensor

Overview of SCROT Sensor Group

SPN	FMI	Description
4363	0	SCROT above Critical Temperature (page 1969)
4363	2	SCROT signal erratic, intermittent or incorrect (page 1972)
4363	3	SCROT signal Out of Range HIGH (page 1974)
4363	4	SCROT signal Out of Range LOW (page 1976)

Overview

Selective Catalyst Reduction Outlet Temperature (SCROT) measures exhaust temperature at outlet of Selective Catalyst Reduction (SCR). SCR temperature sensor module is a smart device that communicates with Aftertreatment Control Module (ACM) via Controller Area Network (CAN). SCROT sensor is part of SCR temperature sensor module, and is not serviceable individually.

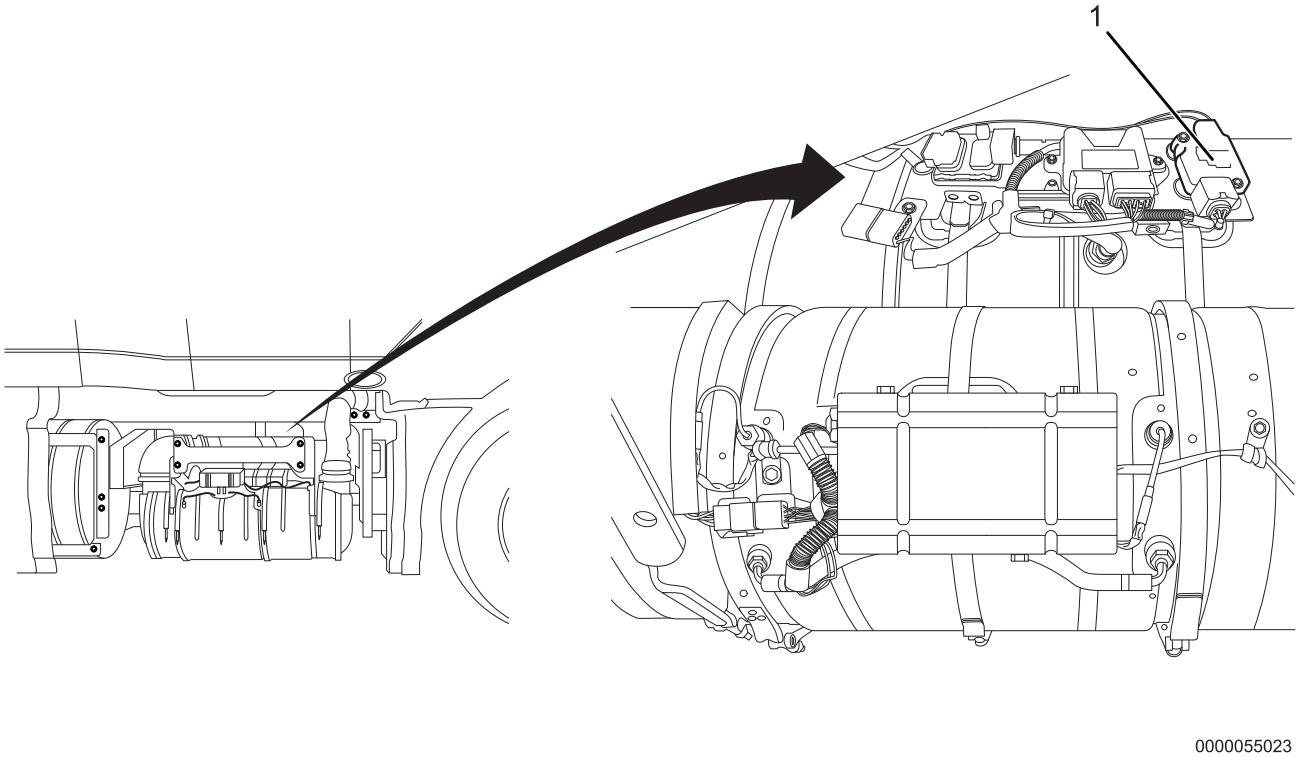


Figure 785 Selective Catalyst Reduction (SCR) Temperature Sensor Module Location

1. SCR temperature sensor module

SPN 4363 FMI 0 - SCROT above Critical Temperature

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Aftertreatment Selective Catalyst Reduction Outlet Temperature (SCROT) continuously above a severe, high threshold.	SCROT > 1472°F (800°C) for more than 20 seconds.	Key-On Engine-Running (KOER).

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects aftertreatment Selective Catalyst Reduction Outlet Temperature (SCROT) sensor reading is greater than 1472°F (800°C) for more than 20 seconds. Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled and engine can be shut down.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 1322-1328 FMI 31 (CYL) • SPN 4765 FMI 0, 15, and 16 (DOCIT)	• SPN 3242 FMI 0, 15, and 16 (DPFIT) • SPN 5743 FMI 3, 4, 11, and 16 (SCR)	• SPN 3246 FMI 0, 15, and 16 (DPFOT)	• SPN 4363 FMI 2, 3, and 4 (SCROT)

Fault Facts

This fault will go inactive after SCROT drops below warning limit, and will likely be inactive when vehicle is in shop. For this reason, these diagnostics must be used for both active and inactive fault codes.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Lube oil leak to exhaust
- Fuel leak to exhaust
- Leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC)
- Leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC)
- Restricted exhaust
- Failed Selective Catalyst Reduction (SCR) temperature sensor module
- Contaminated Diesel Exhaust Fluid (DEF)

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1969). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 4363 FMI 0.

Step 2	Check Diesel Exhaust Fluid (DEF) quality.	Decision
Obtain a sample of DEF. Visually inspect for contamination, and use special tool DEF Refractometer 5025 to test urea concentration of DEF fluid. Is urea concentration between 30 and 34 percent and Not contaminated?		Yes: Go to Step 3. No: Drain the DEF tank, flush with distilled water, and fill with new and / or known good DEF. After repairs are complete, retest for SPN 4363 FMI 0.

Step 3	Check for failed Selective Catalytic Reduction (SCR) temperature sensor module.	Decision
Compare Diesel Oxidation Catalyst Inlet Temperature (DOCIT). Is SCRIT and SCROT difference within 77°F (43°C) of each other?		Yes: Go to Step 4. No: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4363 FMI 0.

Step 4	Inspect for fuel or lube oil leaks to exhaust.	Decision
Remove exhaust plumbing from turbocharger outlet. Inspect turbocharger exhaust outlet for oil or fuel in aftertreatment system from engine. Is turbocharger exhaust outlet free of oil and fuel contamination?		Yes: Go to step 5. No: Repair fuel or lube oil leak to exhaust. After repairs are complete, retest for SPN 4363 FMI 0.

Step 5	Check for leaking or stuck open Aftertreatment Fuel Enable Control (AFT: FEC).	Decision
Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FEC). Perform KOEO DEF System Leak Test(page 2159). Is valve train free of failed valve train components?		Yes: Go to Step 6.
		No: Replace AFT: FEC. After repairs are complete, retest for SPN 4363 FMI 0.

Step 6	Check for leaking or stuck open Aftertreatment Fuel Pressure Control (AFT: FPC).	Decision
Check for leaking or stuck open AFT: FPC. Perform KOER DSI System Test(page 2187). Was correct amount of fuel dispensed?		Yes: Go to Step 7.
		No: Replace AFT: FPC. After repairs are complete, retest for SPN 4363 FMI 0.

Step 7	Check for restricted exhaust.	Decision
Remove Diesel Oxidation Catalyst (DOC). Inspect DOC. Check DOC face for soot accumulation, face plugging, or damage. Are less than 50 percent of cells on intake face completely blocked by soot?		Yes: Reinstall DOC and perform a Parked Regeneration. After repairs are complete, retest for SPN 4360 FMI 0.
		No: Clean or replace DOC. After repairs are complete, retest for SPN 4363 FMI 0.

End Diagnostic Tests
After performing all diagnostic steps, if SPN 4363 FMI 0 remains, verify each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4363 FMI 2 - SCROT signal erratic, intermittent or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Values
Selective Catalytic Reduction Outlet Temperature (SCROT) is not changing with engine operating conditions (in-range but not rational).	Average of temperature difference across SCR catalyst > 162°F (72°C). OR average of temperature difference across SCR catalyst < -162°F (-108°C) -162°F (-72°C) < average of (DPF outlet temperature - SCR intake temperature) < 162°F (72°C).	Key ON Engine Speed > 200 RPM 302°F (150°C) < SCR intake temperature < 1112°F (600°C) OR 302°F (150°C) < SCR outlet temperature < 1112°F (600°C) Elapsed time since last active regeneration > 1200 seconds Engine Coolant temperature > 140°F (60°C) Inactive: SPN 4360 FMI 3 and 4 (SCRIT); SPN 4363 FMI 3 and 4 (SCROT); and SPN 5743 FMI 3, 4, and 11 (SCR temp sensor module

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction Outlet Temperature (SCROT) sensor does not match engine operating conditions for more than 5 minutes. A default value for SCROT is used and Diesel Exhaust Fluid (DEF) injection into aftertreatment system is disabled. Engine torque will be reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

• SPN 4360 FMI 3 and 4 (SCRIT)	• SPN 4363 FMI 3 and 4 (SCROT)	• SPN 5743 FMI 3, 4, 11, and 16 (SCR)	

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) Temperature Sensor Module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1972). Is EST DTC list free of Associated Faults?		Yes: Replace SCR temperature sensor module. After repairs are complete, retest for SPN 4363 FMI 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4363 FMI 2.

End Pin-Point Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4363 FMI 3 - SCROT signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Selective Catalyst Reduction (SCR) temperature sensor module is shorted to battery or open circuit in SCR Outlet Temperature (SCROT) sensor circuit.	SCROT sensor input voltage ≥ 5 volts or SCROT sensor resistance ≥ 10 ohms	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) detects Selective Catalyst Reduction Outlet Temperature (SCROT) sensor circuit is shorted to battery or open for 16 seconds. Active and parked regeneration will be disabled and engine torque reduced. Engine torque will be severely reduced and vehicle speed will be limited after extended engine operation with this fault code active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5743 FMI 3, 4, 11, 16 (SCR)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1974). Is EST DTC free of Associated Faults?		Yes: Replace SCR temperature sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4363 FMI 3.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4363 FMI 3.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4363 FMI 3 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

SPN 4363 FMI 4 - SCROT signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Values
Selective Catalyst Reduction (SCR) temperature sensor module is shorted to ground in the SCR Outlet Temperature (SCROT) sensor circuit.	SCROT input voltage ≤ 1 volt	Key ON

Fault Overview

Fault code sets when Aftertreatment Control Module (ACM) has detected an internal circuit error in Selective Catalyst Reduction (SCR) temperature sensor module, and SCR Outlet Temperature (SCROT) sensor signal voltage is less than 1 volt for 16 seconds. Active and parked regeneration will be disabled and engine torque reduced if engine is operated for an extended period of time with this fault active.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 5743 FMI 3, 4, 11, 16 (SCR)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Failed Selective Catalyst Reduction (SCR) temperature sensor module

Step 1	Check for associated faults.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1976). Is EST DTC free of Associated Faults?		Yes: Replace SCR temperature sensor module. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4363 FMI 4.
		No: Repair Associated Faults. After repairs are complete, perform the SCR Maintenance Reset Procedure (page 2170) and retest for SPN 4363 FMI 4.

End Diagnostic Steps
After performing all diagnostic steps, if SPN 4363 FMI 4 remains, verify if each step was completed correctly and proper decision was made. Notify supervisor for further action.

TC2CIT (Turbocharger 2 Compressor Intake Temperature)

Overview of TC2CIT Sensor Group

SPN	FMI	Description
1173	2	TC2CIT signal erratic, intermittent, or incorrect (page 1979)
1173	3	TC2CIT signal Out of Range HIGH (page 1985)
1173	4	TC2CIT signal Out of Range LOW (page 1991)
1173	16	TC2CIT signal above desired (Low Pressure CAC Interstage under cooling) (page 1995)

Overview

Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor provides feedback signal to Engine Control Module (ECM) indicating temperature of charge air leaving compressor of high-pressure turbocharger.

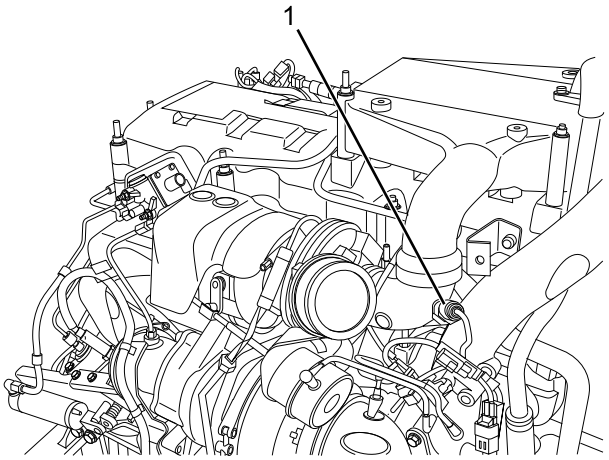


Figure 786 Turbocharger 2 Compressor Intake Temperature (TC2CIT) Sensor Location

1. TC2CIT sensor

SPN 1173 FMI 2 - TC2CIT signal erratic, intermittent, or incorrect

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Turbocharger 2 Compressor Inlet Temperature (TC2CIT) does not agree with other sensors	Difference between TC2CIT and other temperature sensors > 59°F (15°C)	Key ON Engine is cold soaked Engine Coolant Temperature 1 (ECT1) ≥ -40°F (-40°C) ECT1, CACOT, IMT, IAT, and EOT are all within 59°F (15°C) of each other

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that difference between Turbocharger 2 Compressor Inlet Temperature (TC2CIT) sensor reading and other temperature sensor reading is greater than 59°F (15°C).

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

SPN 2630 FMI 3 and 4 (CACOT)			

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous (After Cold Soak)

Possible Causes

- High resistance in TC2CIT circuit
- High resistance in SIG GND circuit
- Failed TC2CIT sensor

Step 1	Check for associated fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for Associated Faults(page 1979). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2. No: Repair Associated Faults. After repairs are complete, retest for SPN 1173 FMI 2.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Codes (DTC) list for SPN 1173 FMI 2. Is EST DTC list SPN 1173 FMI 2 active or pending?		Yes: Go to Step 3. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Inspect connections at Turbocharger 2 Compressor Intake Temperature (TC2CIT) connector.	Decision
A. Key OFF. B. Disconnect TC2CIT connector. C. Check TC2CIT and connector terminals for: damaged or pinched wires; moisture or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2CIT connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1173 FMI 2.

Pin-Point Tests (SPN 1173 FMI 2)

TC2CIT Circuit

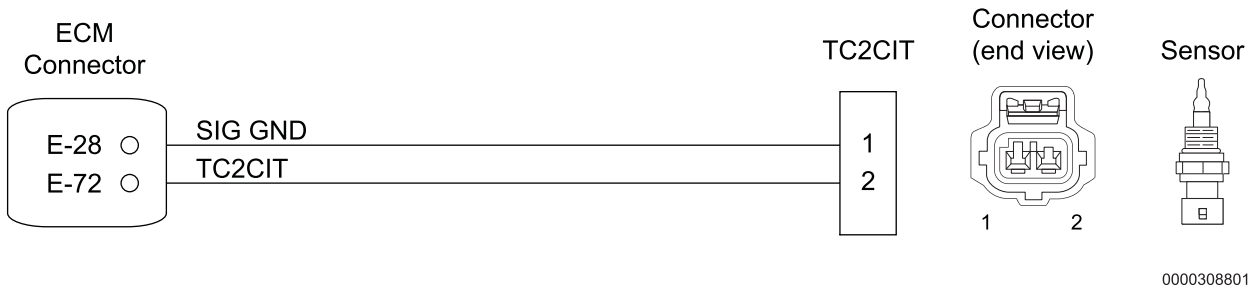
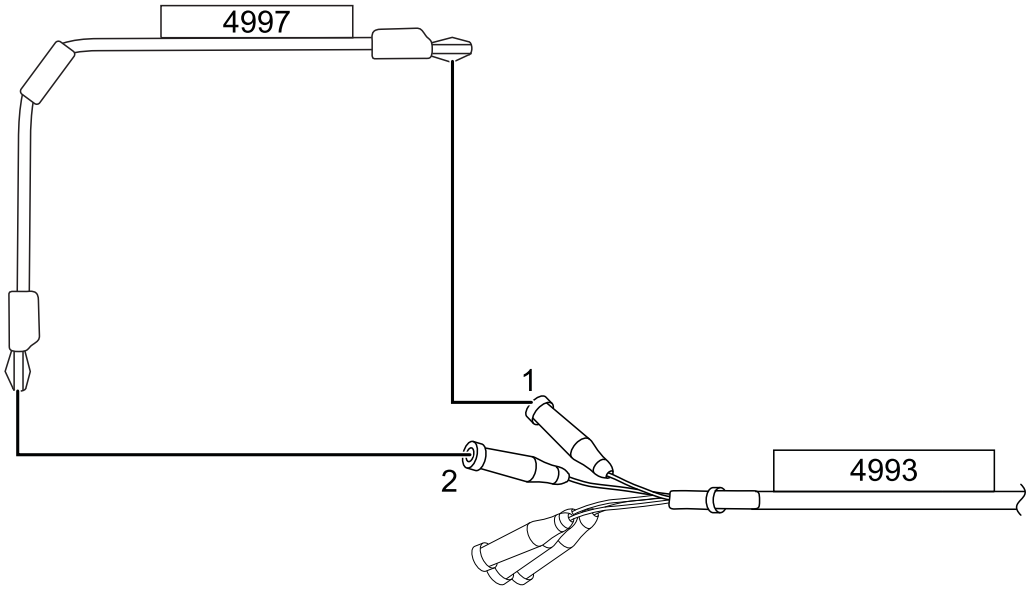


Figure 787 Turbocharger 2 Compressor Inlet Temperature (TC2CIT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4993
- 500 Ohm Resistor Harness ZTSE4497
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000334581

Figure 788 Test 1 TC2CIT Signal Circuit Check

Test 1 Setup
A. Key OFF. B. Disconnect Turbocharger 2 Compressor Inlet Temperature (TC2CIT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave TC2CIT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-1 and pin-2. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™ software, monitor turbocharger compressor inlet temperature.	307.7 ± 10°F (153.2 ± -12.2°C)
Decision	
Is temperature 307.7 ± 10°F (153.2 ± -12.2°C)?	Yes: Replace TC2CIT sensor. After repairs are complete, retest for SPN 1173 FMI 2.
	No: Go to Test 2.

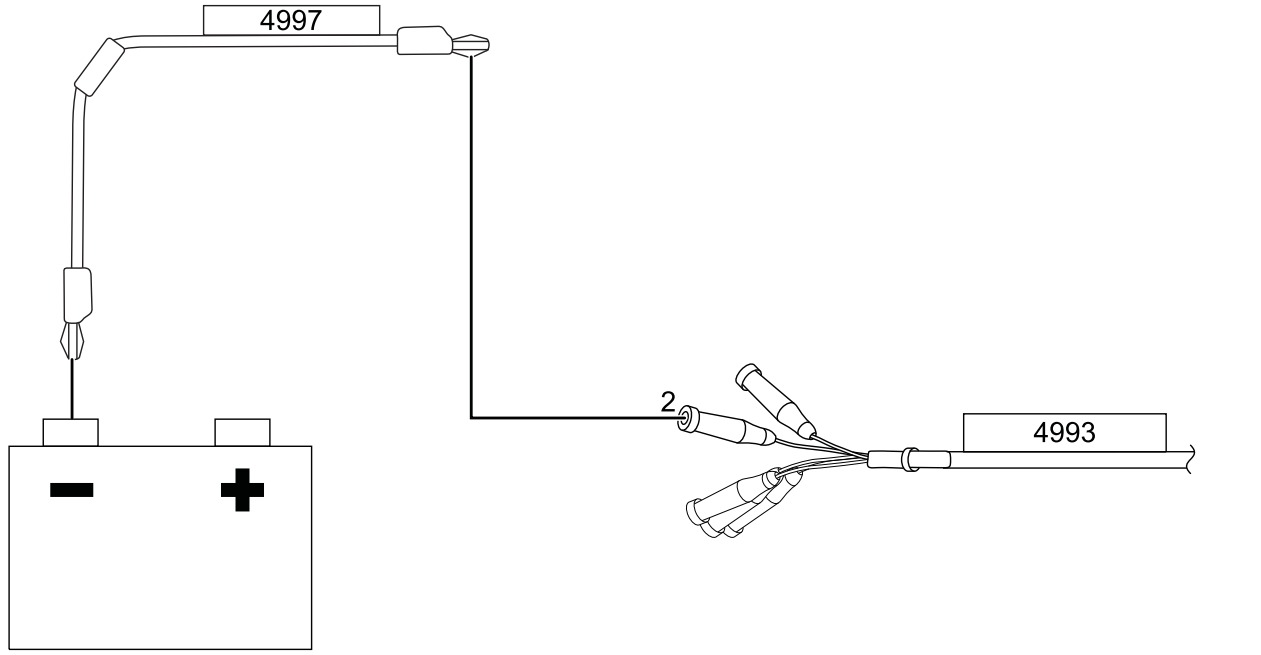


Figure 789 Test 2 TC2CIT Signal Circuit Check

Test 2 Setup
A. Key OFF. B. Disconnect Turbocharger 2 Compressor Inlet Temperature (TC2CIT) sensor. C. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave TC2CIT sensor disconnected. D. Connect Resistor Harness ZTSE4497 between Breakout Harness ZTSE4993 pin-2 and known good GND. E. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). F. Key ON. Log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™ software, monitor turbocharger compressor inlet temperature.	307.7 ± 10°F (153.2 ± -12.2°C)
Decision	
Is temperature 307.7 ± 10°F (153.2 ± -12.2°C)?	Yes: Replace SIG GND circuit between TC2CIT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 1173 FMI 2.
	No: Replace SIG circuit between TC2CIT pin-2 and ECM pin E-72. After repairs are complete, retest for SPN 1173 FMI 2.

End Diagnostic Steps
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 1173 FMI 2 fault code diagnostics.

SPN 1173 FMI 3 - TC2CIT Signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Values
Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor signal reading is greater than expected	TC2CIT sensor voltage > 4.805 volts {< -49°F (-45°C)}	Key ON

Fault Overview

Fault Code sets when Engine Control Module (ECM) detects that Turbocharger 2 Compressor Intake Temperature (TC2CIT) signal is greater than 4.8 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- TC2CIT circuit Open
- TC2CIT circuit short to PWR
- SIG GND circuit Open
- Failed TC2CIT sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 1173 FMI 3. Is EST DTC list SPN 1173 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor.	Decision
A. Key OFF. B. Disconnect TC2CIT sensor connector. C. Check TC2CIT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2CIT sensor, connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1173 FMI 3.

Pin-Point Tests (SPN 1173 FMI 3)

TC2CIT Circuit

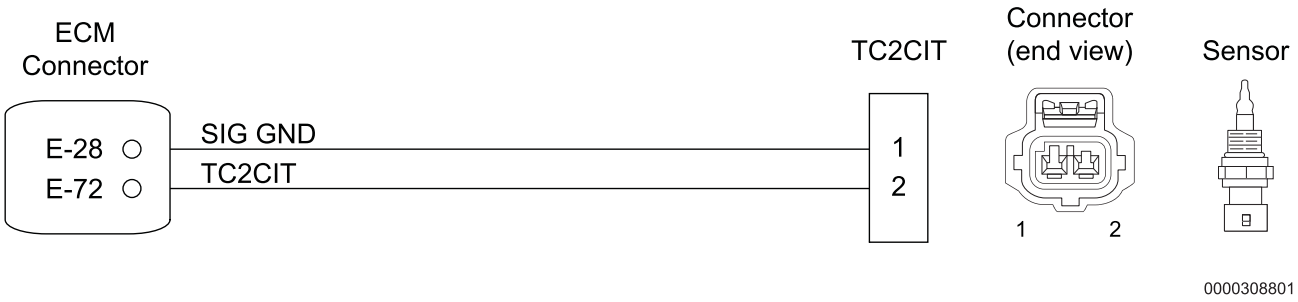


Figure 790 Turbocharger 2 Compressor Intake Temperature (TC2CIT) Sensor Circuit Diagram

NOTE: See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4993
- Breakout Harness Banana Plug ZTSE4498
- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

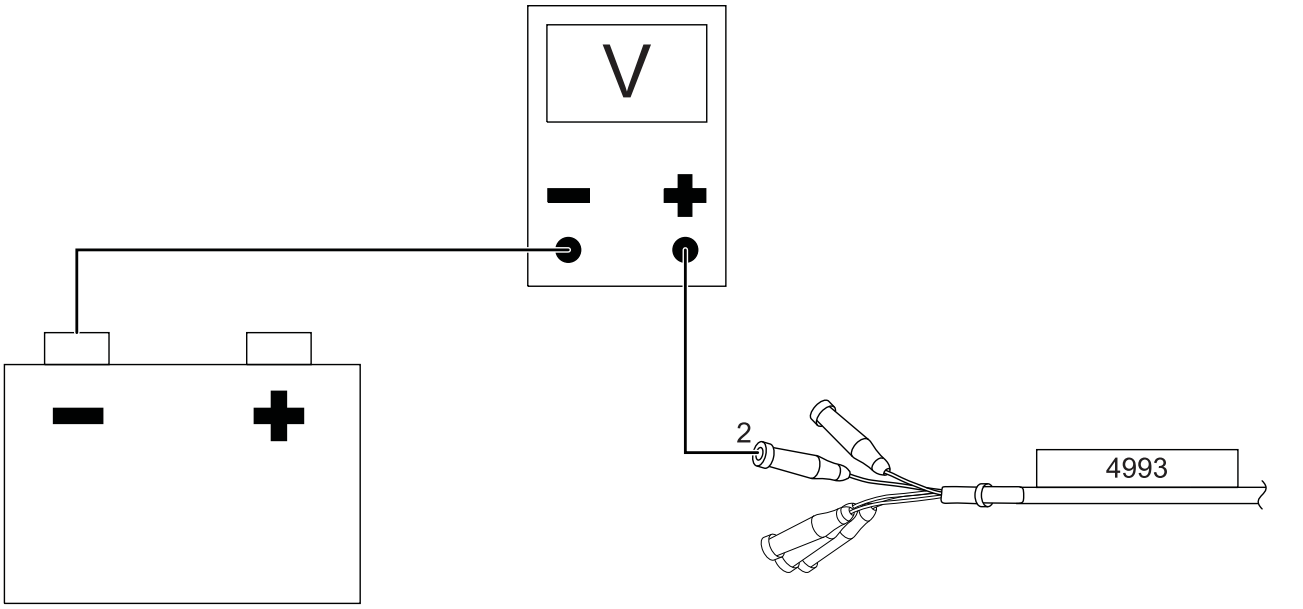
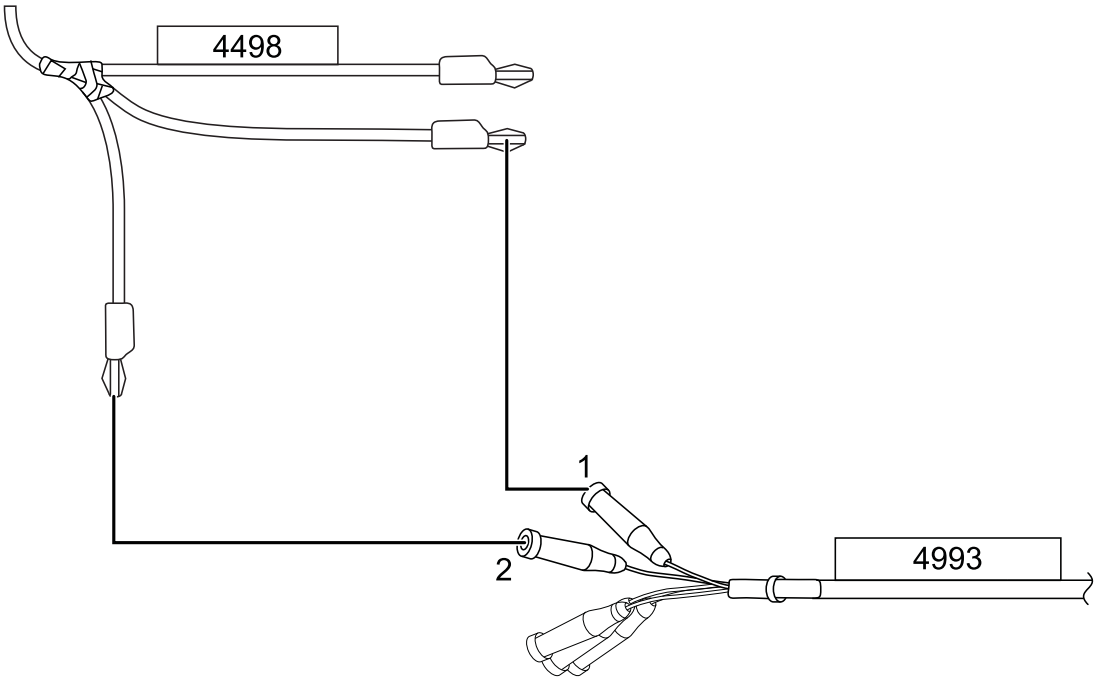


Figure 791 Test 1 TC2CIT Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness connector and leave Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor disconnected. C. Key ON.

Test 1	Specification
Using Digital Multimeter (DMM), measure voltage between Breakout Harness ZTSE4993 pin-2 and ground.	Less than 6 volts
Decision	
Is voltage greater than 6 volts?	Yes: Repair short to PWR between TC2CIT pin-2 and Engine Control Module (ECM) pin E-72. After repairs are complete, retest for SPN 1173 FMI 3.
	No: Go to Test 2.

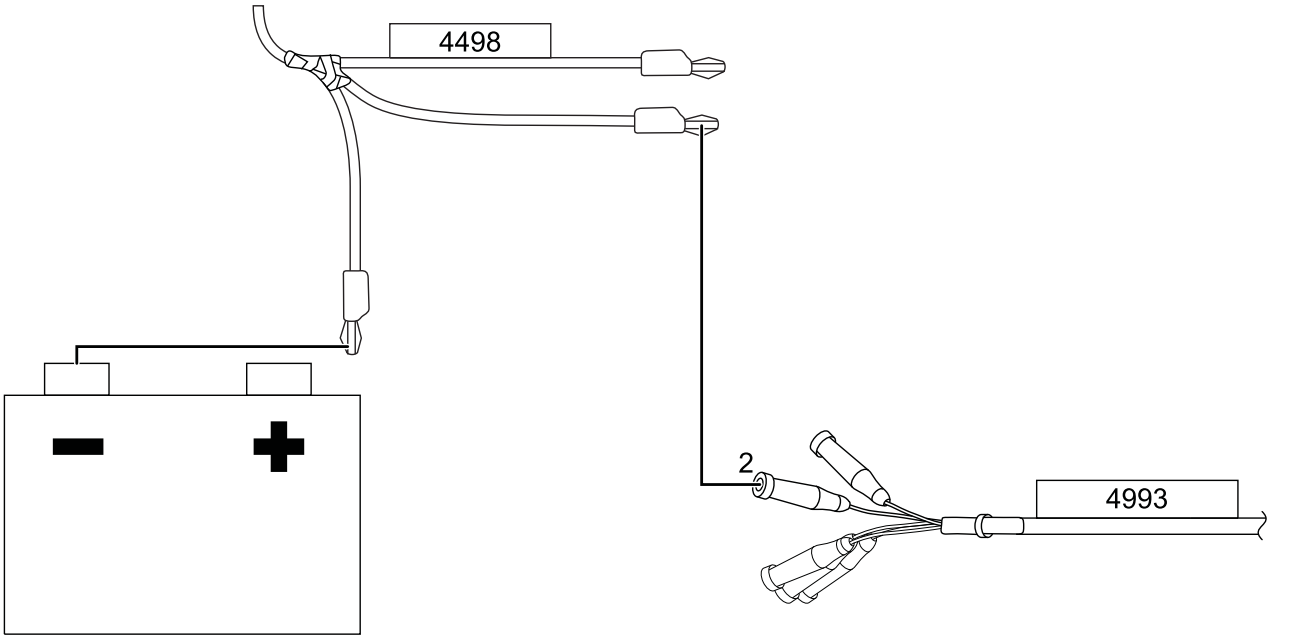


0000301703

Figure 792 Test 2 TC2CIT Sensor Circuit Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness and leave TC2CIT sensor disconnected. C. Using Breakout Harness ZTSE4498, short pin-1 and pin-2 of Breakout Harness ZTSE4493 together. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON, log in to ServiceMaxx™ software.

Test 2	Specification
Using EST with ServiceMaxx™, clear DTC list.	SPN 1173 FMI 4 sets
Decision	
Does SPN 1173 FMI 4 set after DTC list is cleared?	Yes: Replace TC2CIT sensor. After repairs are complete, retest for SPN 1173 FMI 3.
	No: Go to Test 3.



0000308722

Figure 793 Test 3 TC2CIT Sensor Circuit Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4993 to vehicle harness and leave TC2CIT sensor disconnected. C. Using Breakout Harness ZTSE4498, short Breakout Harness ZTSE4993 pin-2 to ground. D. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). E. Key ON, log in to ServiceMaxx™ software.

Test 3	Specification
Using EST with ServiceMaxx™, clear DTC list.	SPN 1173 FMI 4 sets
Decision	
Does SPN 1173 FMI 4 set after DTC list is cleared?	Yes: Repair Open between TC2CIT pin-1 and ECM pin E-28. After repairs are complete, retest for SPN 1173 FMI 3.
	No: Repair Open between TC2CIT pin-2 and ECM pin E-72. After repairs are complete, retest for SPN 1173 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify each step was completed correctly and the proper decision was made. Return to SPN 1173 FMI 3 fault code diagnostics.

SPN 1173 FMI 4 - TC2CIT Signal Out of Range LOW

Condition/Description	Setting Criteria	Enable Conditions/ Values
Turbocharger 2 Compressor Intake Temperature (TC2CIT) signal reading is lower than expected.	TC2CIT sensor reading < 0.195 volts (> 397°F [203°C])	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects Turbocharger 2 Compressor Intake Temperature (TC2CIT) signal is less than 0.195 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON

Possible Causes

- Turbocharger 2 Compressor Intake Temperature (TC2CIT) circuit short to GND
- Failed TC2CIT

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 1173 FMI 4. Is EST DTC list SPN 1173 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor.	Decision
A. Key OFF. B. Disconnect TC2CIT sensor connector. C. Check TC2CIT sensor and connector terminals for damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2CIT sensor, connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1173 FMI 4.

Pin-Point Tests (SPN 1173 FMI 4)

TC2CIT Circuit



Figure 794 Turbocharger 2 Compressor Intake Temperature (TC2CIT) Sensor Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant supporting, J1939 and J1708)

Test 1 Setup
A. Key OFF. B. Disconnect Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor. C. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124). D. Key ON. Log in to Servicemaxx™ software.

Test 1	Specification
Using EST with ServiceMaxx™software, clear DTC list.	SPN 1173 FMI 3 sets in DTC list
Decision	
Does SPN 1173 FMI 3 set in DTC list?	Yes: Replace TC2CIT sensor. After repairs are complete, retest for SPN 1173 FMI 3.
	No: Repair short to GND between TC2CIT pin-2 and Engine Control Module (ECM) pin E-72. After repairs are complete, retest for SPN 1173 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 1173 FMI 4 fault code diagnostics.

SPN 1173 FMI 16 - TC2CIT signal above desired (Low Pressure CAC Interstage under cooling)

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Low pressure charge air cooler effectiveness	Turbocharger # 2 Compressor Inlet temperature value MINUS Engine Inlet Air temperature value > Threshold defined by Speed/Torque table (Table A001) * Mass Air Flow modifier table (Table A002) * Coolant Temperature modifier table (Table A003) * Inlet Air Temperature modifier table (Table A004) * Atmospheric Pressure modifier table (Table A005)	Particulate Filter Regeneration NOT Active SCR Warm-up Not Active Barometric Pressure ≥ 10.7 psi (73.5 kPa) AND ≤ 14.9 psi (103 kPa) Power Take Off Mode NOT Active End Of Line Testing NOT Active [Engine Brake (Retarder) NOT active AND minimum wait time after retarder change of state has occurred] Engine Torque limitation NOT Active Engine is NOT coasting (i.e. Throttle Cut OFF mode) Battery Voltage ≥ 9 Volts AND ≤ 16 Volts Engine Ignition Key is in "ON" position (Key ON) Time after engine start ≥ 30 seconds Engine Coolant Temperature > 68°F (20°C) AND < 219°F (104°C) Monitor Enabled based on Speed/Torque table (Table A006) Monitor Enabled based on Engine Air Inlet Temperature (Table A007) 102/3, 102/4, 102/7, 102/16, 105/2, 105/3, 105/4, 108/3, 108/4, 110/2, 110/3, 110/4, 132/3, 132/4, 172/2, 172/3, 172/4, 191/3, 191/4, 651/4, 651/5, 652/4, 652/5, 653/4, 653/5, 654/4, 654/5, 655/4, 655/5, 656/4, 656/5, 1173/2 are NOT active

Fault Overview

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

CONTENT
UNDER
DEVELOPMENT

0000305681

See iKNow Article IK0900087 for information on this fault code.

TC2WG (Turbocharger 2 Wastegate Position)

Overview of TC2WG Group

SPN	FMI	Description
1189	3	TC2WC short to PWR (page 1998)
1189	4	TC2WC Open or short to GND (page 2002)

Overview

Engine Control Module (ECM) commands Turbocharger 2 Wastegate Position (TC2WG) to control turbocharger pneumatic actuator.

SPN 1189 FMI 3 - TC2WC short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Turbocharger 2 Wastegate (TC2WG) shorted to power (PWR).	Current through TC2WG circuit > 1 amp for 20 microseconds, or > 2 amp for 2 microseconds	Engine Turbocharger 2 Wastegate Drive position command (PWM frequency) for short circuit to battery detection ≥ 0.003 % Battery power ≥ 9 volts

Fault Overview

Fault code sets when Electronic Control Module (ECM) determines that Turbocharger 2 Wastegate Position (TC2WG) circuit is shorted to a power source for 25.5 seconds. TC2WG circuit current is greater than 1 amp for 20 microseconds or greater than 2 amps for 2 microseconds.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during one drive cycle.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON

Possible Causes

- TC2WG ground side switch circuit short to PWR
- Failed Turbocharger 2 Wastegate (TC2WG) valve

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 1189 FMI 3. Is EST DTC list SPN 1189 FMI 3 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Turbocharger 2 Wastegate Position (TC2WG) connector.	Decision
A. Key OFF. B. Disconnect TC2WG connector. C. Check TC2WG and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2WG connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1189 FMI 3.

Pin-Point Tests SPN 1189 FMI 3

TC2WG Circuit

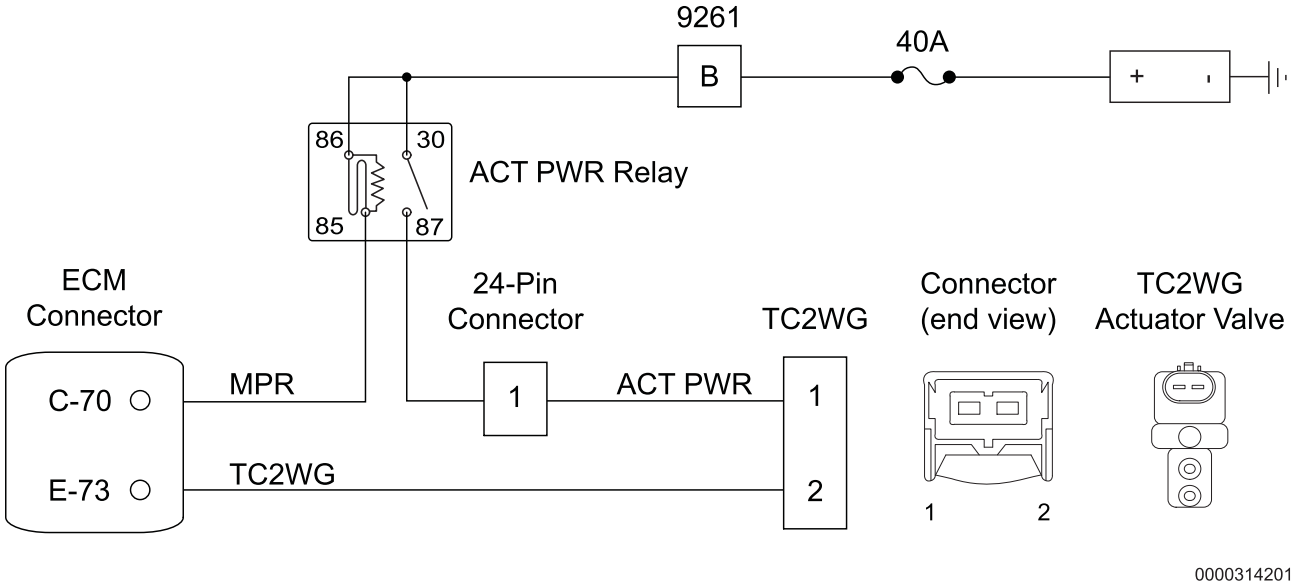


Figure 796 TC2WG Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Digital Multimeter (DMM)
- Breakout Harness (TC2WG) ZTSE4831

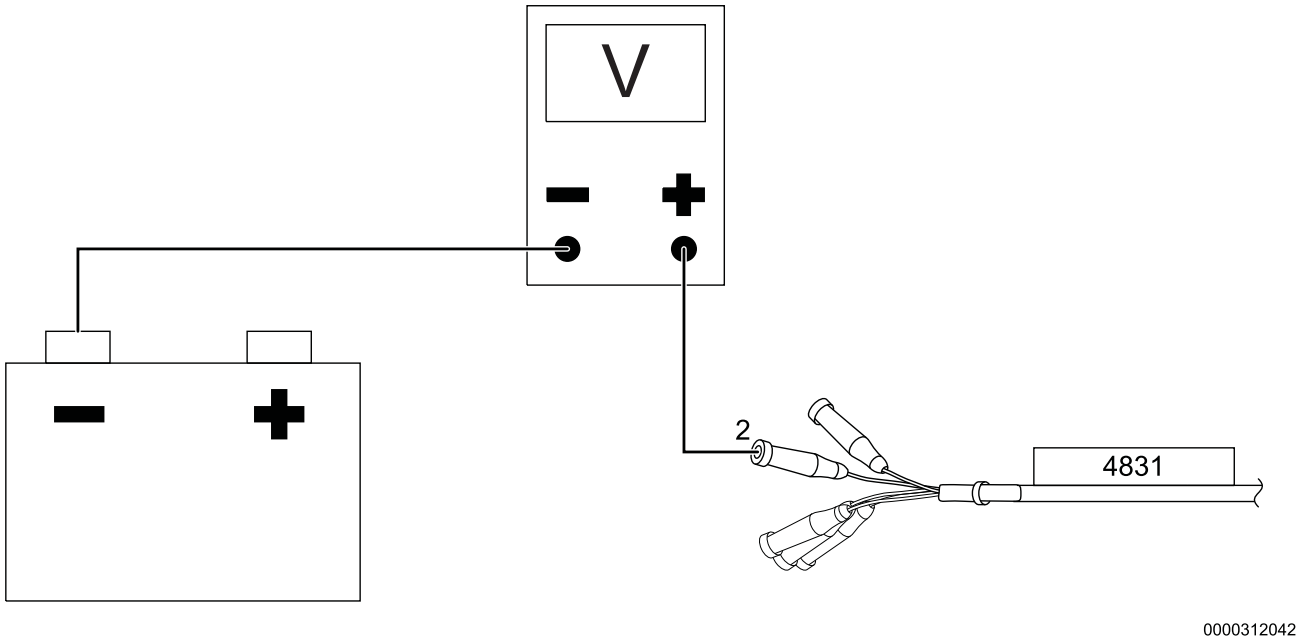


Figure 797 Test 1 Turbocharger 2 Wastegate Position (TC2WG) Actuator Valve Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4831 to vehicle harness and leave Turbocharger 2 Wastegate (TC2WG) actuator valve disconnected. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4831 pin-2 and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts?	Yes: Repair short to PWR between TC2WG pin-2 and Engine Control Module (ECM) pin E-73. After repairs are complete, retest for SPN 1189 FMI 3.
	No: Replace TC2WG Actuator valve. After repairs are complete, retest for SPN 1189 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 1189 FMI 3 fault code diagnostics.

SPN 1189 FMI 4 - TC2WC Open or short to GND

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Turbocharger 2 Wastegate (TC2WG) circuit shorted to ground or open circuit.	Voltage at power stage output < 2.175 volts Voltage at power stage output > 2.9 volts and < 3.2 volts	Key ON Battery power ≥ 9 volts Turbocharger 2 Wastegate (TC2WG) drive position command (PWM frequency) for short circuit to ground detection {Calibrated out} ≤ 99.5 % TC2WG drive position command (PWM frequency) for open loop detection ≥ 0.003 %

Fault Overview

Fault code sets when Engine Control Module (ECM) determines that Turbocharger 2 Wastegate Position (TC2WG) circuit is shorted to ground or open.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Key ON

Possible Causes

- Turbocharger 2 Wastegate Position (TC2WG) ground side switch circuit open
- TC2WG ground side switch circuit shorted to GND
- ACT PWR circuit Open
- Failed TC2WG

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software, check Diagnostic Trouble Code (DTC) list for SPN 1189 FMI 4. Is EST DTC list SPN 1189 FMI 4 active or pending?		Yes: Go to Step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Inspect connections at Turbocharger 2 Wastegate Position (TC2WG) connector.	Decision
A. Key OFF. B. Disconnect TC2WG connector. C. Check TC2WG and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TC2WG connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Test . No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 1189 FMI 4.

Pin-Point Tests (SPN 1189 FMI 4)

TC2WG Circuit

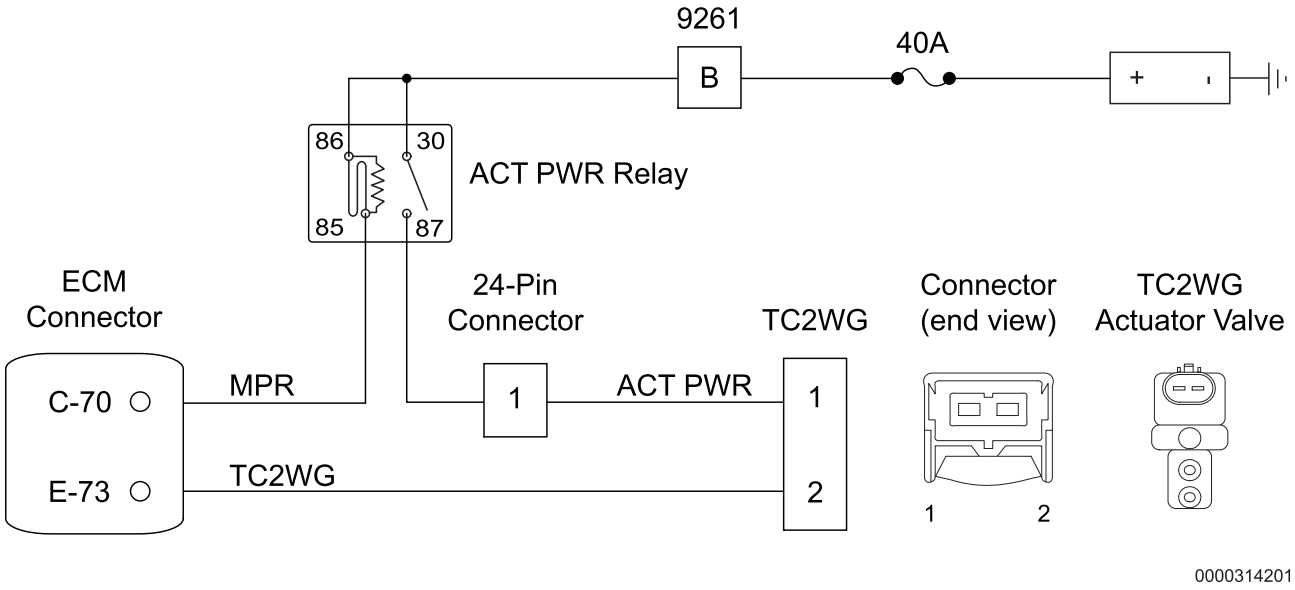


Figure 798 Turbocharger 2 Wastegate (TC2WG) Circuit Diagram

See latest version of Navistar® N9 and N10 Engine and Aftertreatment Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Digital Multimeter (DMM)
- TC2WG Breakout Harness ZTSE4831

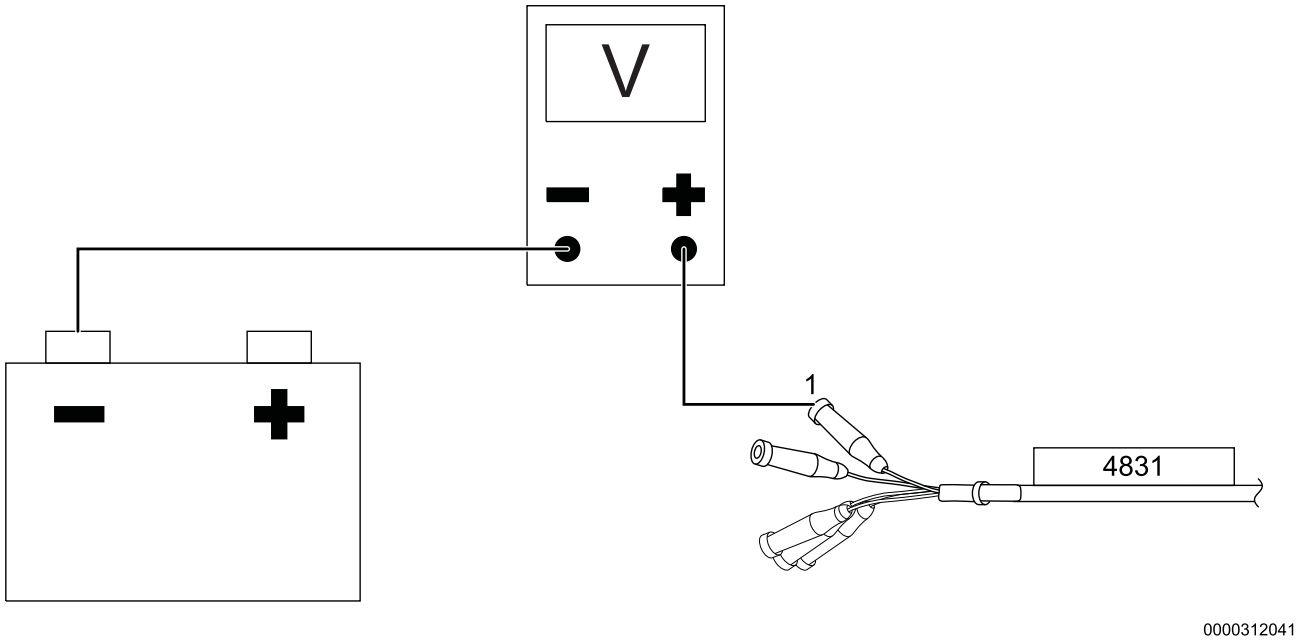


Figure 799 Test 1 Turbocharger 2 Wastegate Position (TC2WG) Voltage Check

Test 1 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4831 to vehicle harness and leave Turbocharger 2 Wastegate (TC2WG) disconnected. C. Key-On Engine-Off (KOEO).

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4831 pin-1 and known good ground.	B+ ± 0.5 volt
Decision	
Is voltage B+ ± 0.5 volt?	Yes: Go to Test 2.
	No: Repair Open circuit between TC2WG pin-1 and ACT PWR Relay pin-87. After repairs are complete, retest for SPN 1189 FMI 4.

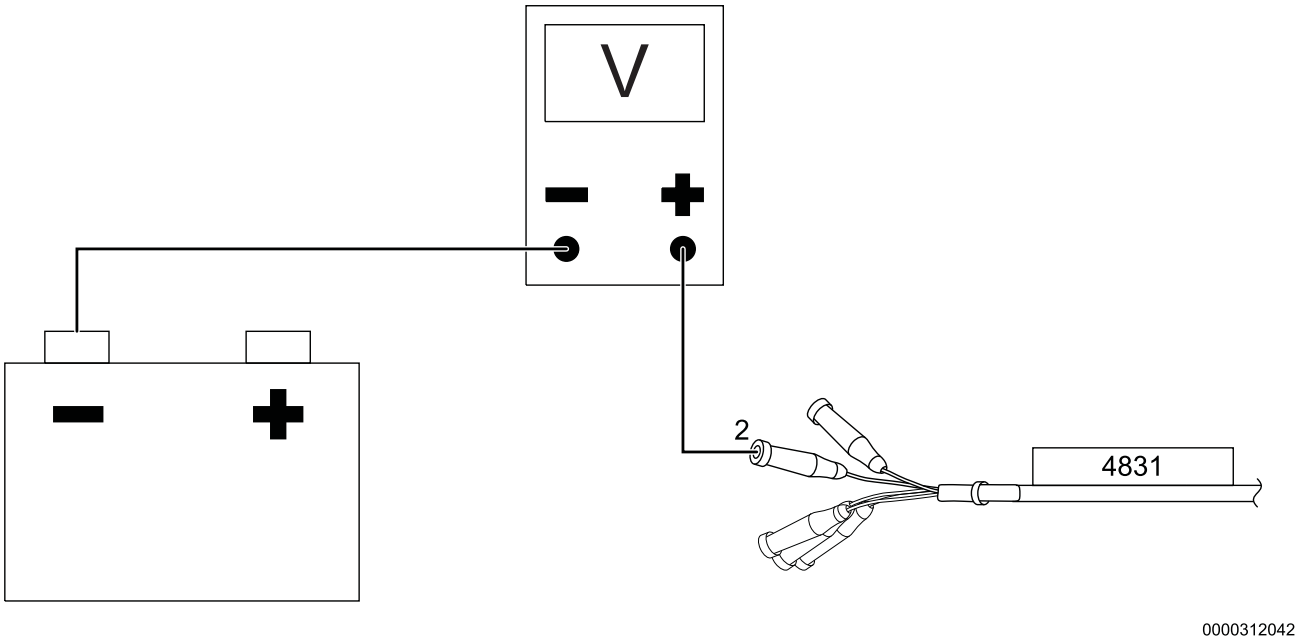


Figure 800 Test 2 Turbocharger 2 Wastegate Position (TC2WG) Voltage Check

Test 2 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4831 to vehicle harness and leave Turbocharger 2 Wastegate Position (TC2WG) disconnected. C. KOEO.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4831 pin-2 and known good ground.	less than 0.5 volts
Decision	
Is voltage less than 0.5 volts?	Yes: Go to Test 3.
	No: Replace TC2WG actuator valve. After repairs are complete, retest for SPN 1189 FMI 4.

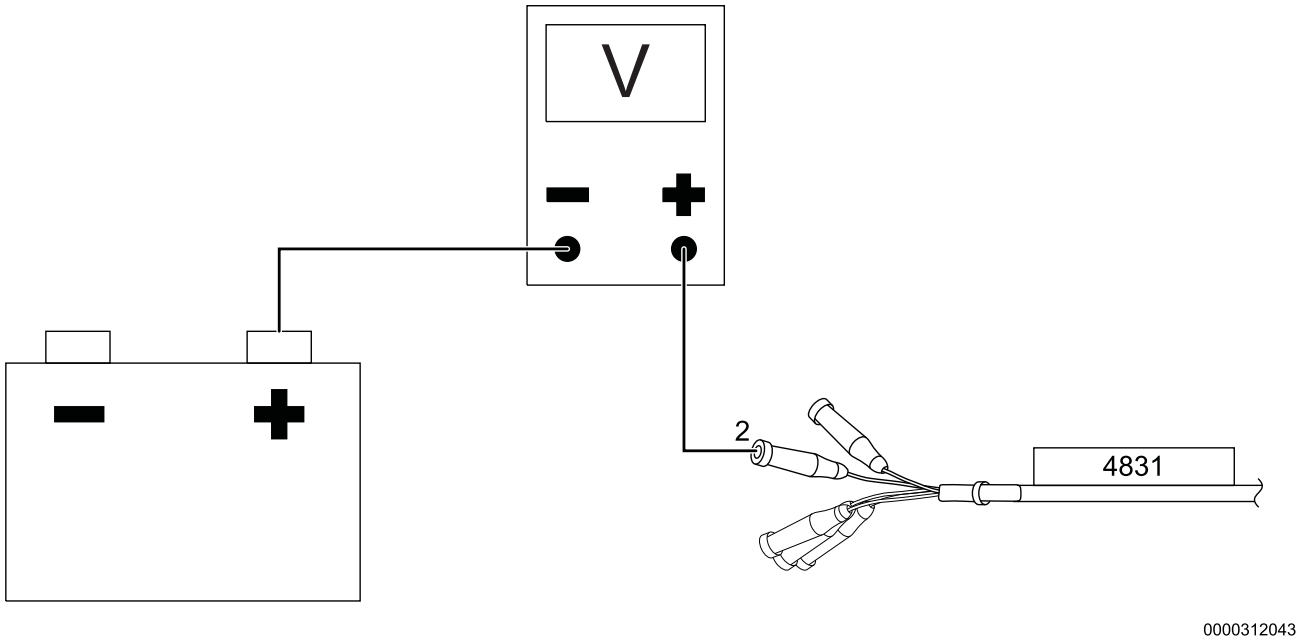


Figure 801 Test 3 Turbocharger 2 Wastegate Position (TC2WG) Voltage Check

Test 3 Setup
A. Key OFF. B. Connect Breakout Harness ZTSE4831 to vehicle harness and leave Turbocharger 2 Wastegate Position (TC2WG) disconnected. C. KOEO.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4831 pin-2 and PWR.	± 0.5 volt of battery voltage
Decision	
Is voltage within 0.5 volt of battery voltage?	Yes: Repair short to GND between TC2WG pin-2 and ECM pin E-73. After repairs are complete, retest for SPN 1189 FMI 4.
	No: Repair Open between TC2WG pin-2 and ECM pin E-73. After repairs are complete, retest for SPN 1189 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 1189 FMI 4 fault code diagnostics.

TOSS (Transmission Output Shaft Speed) Sensor

Overview of TOSS Sensor Group

SPN	FMI	Description
191	3	TOSS/VSS signal out of range HIGH (page 2010)
191	4	TOSS/VSS signal out of range LOW (page 2014)
191	5	TOSS/VSS Open Circuit fault (page 2018)
191	14	TOSS/VSS Error invalid signal (page 2018)

Overview

Transmission tail shaft speed is detected by a magnetic pickup mounted on the transmission that senses rotation of a 16 toothed gear installed on rear of the transmission. Alternating Current (AC) sine wave signal is received by Engine Control Module (ECM) and is utilized along with tire size and axle ratio, to calculate vehicle speed. Calculated vehicle speed is transmitted to the instrument cluster through Drive Train Data Link to operate the speedometer within the instrument cluster. Calculated vehicle speed is also utilized in control strategies that control features such as Cruise Control, PTO operation and Road Speed Limiting.

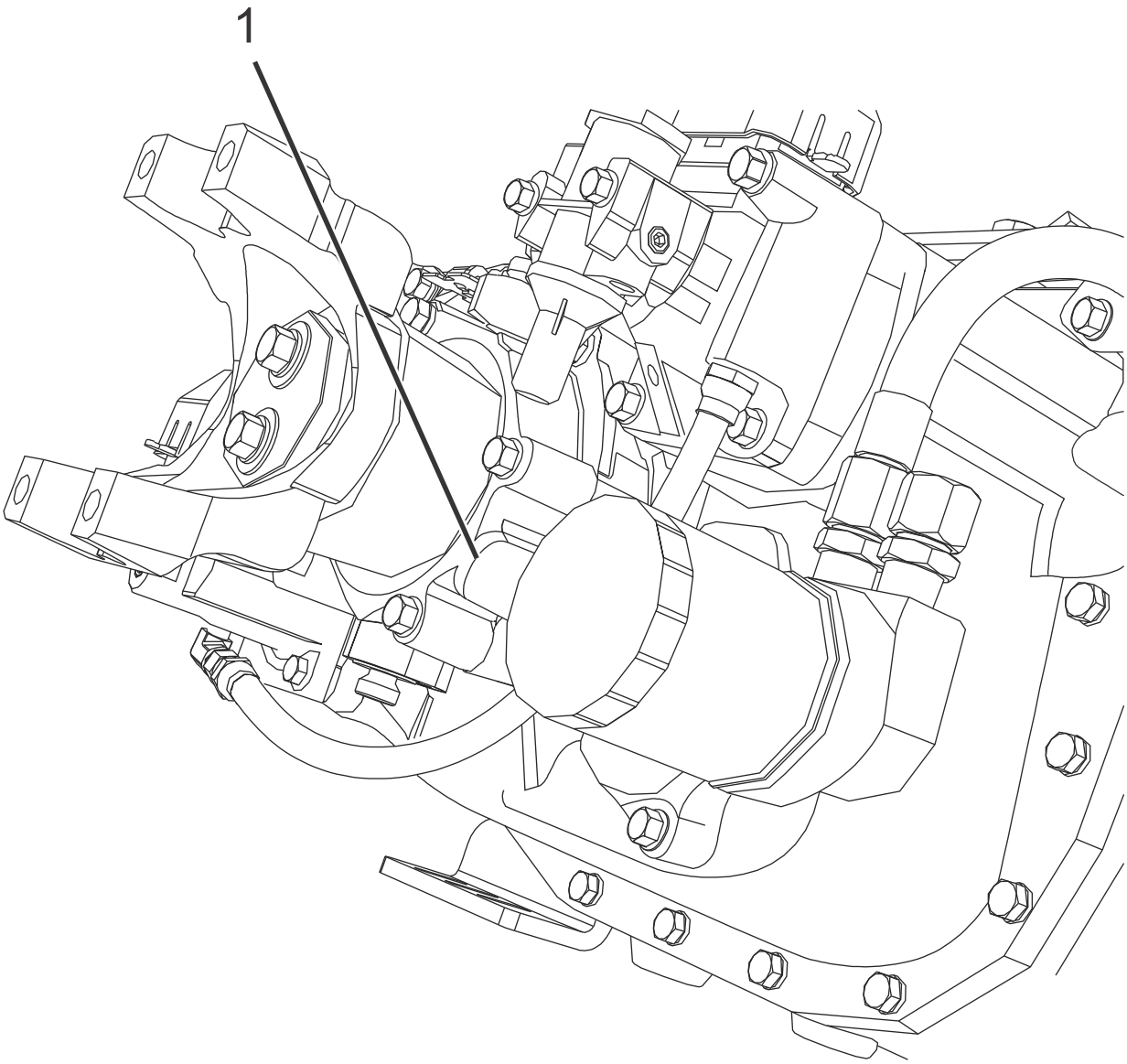


Figure 802 TOSS / VSS Location (Typical)

SPN 191 FMI 3 - TOSS/VSS signal out of range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Transmission Output Shaft Speed signal Out of Range High	Transmission sensor voltage (VSS +) > 4.492 Volts OR Transmission sensor voltage (VSS -) > 4.492 Volts	Key ON [Vehicle speed sensor signal frequency ≤ 0.2 Hz for] ≥ 0.5 seconds Manual Transmission Selected (Manual Isochronous and non-Isochronous: Allison AT/MT)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) signal is out of range high.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- TOSS-H Short to B+
- TOSS-L Short to B+

Step 1	Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) sensor and connector inspection	Decision
A. Key OFF. B. Disconnect TOSS/VSS sensor. C. Check TOSS/VSS sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TOSS/VSS sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 191 FMI 3.

Pin-Point Tests (SPN 191 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

Test 1 Setup
A. Key OFF. B. Disconnect TOSS/VSS sensor connector. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into TOSS/VSS vehicle harness and leave TOSS/VSS disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between TOSS/VSS vehicle harness pin-1 and known good GND.	Less than 1.7 volts
Decision	
Is voltage Less than 1.7 volts?	Yes: Repair short to B+ in TOSS-L circuit. After repairs are complete, retest for SPN 191 FMI 3.
	No: Repair short to B+ in TOSS-H circuit. After repairs are complete, retest for SPN 191 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 191 FMI 3 fault code diagnostics.

SPN 191 FMI 4 - TOSS/VSS signal out of range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Transmission Output Shaft Speed signal Out of Range Low	Transmission sensor voltage (VSS +) > 4.492 Volts OR Transmission sensor voltage (VSS -) < 0.488 Volts	Key ON [Vehicle speed sensor signal frequency ≤ 0.2 Hz for] ≥ 0.5 seconds Manual Transmission Selected (Manual Isochronous and non-Isochronous: Allison AT/MT)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) signal is out of range low.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- TOSS-H Short to GND
- TOSS-L Short to GND

Step 1	Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) sensor and connector inspection	Decision
A. Key OFF. B. Disconnect TOSS/VSS sensor. C. Check TOSS/VSS sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TOSS/VSS sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 191 FMI 4.

Pin-Point Tests (SPN 191 FMI 4)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

Test 1 Setup
A. Key OFF. B. Disconnect TOSS/VSS sensor connector. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into TOSS/VSS vehicle harness and leave TOSS/VSS disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between TOSS/VSS vehicle harness pin-1 and known good GND.	Less than 1.2 volts
Decision	
Is voltage Less than 1.2 volts?	Yes: Repair short to GND in TOSS-L circuit. After repairs are complete, retest for SPN 191 FMI 4.
	No: Repair short to GND in TOSS-H circuit. After repairs are complete, retest for SPN 191 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 191 FMI 4 fault code diagnostics.

SPN 191 FMI 5 - TOSS/VSS Open Circuit fault

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Transmission Output Shaft Speed Open Circuit	Transmission sensor voltage (VSS +) > 1.211 Volts AND < 1.699 Volts	Key ON [Vehicle speed sensor signal frequency ≤ 0.2 Hz AND for] ≥ 0.5 seconds Auto Transmission Selected (Allison, Eaton, DANA transmission selected)

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) has an open circuit.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- TOSS-H circuit open
- TOSS-L circuit open
- Failed TOSS/VSS sensor

Step 1	Transmission Output Shaft Speed / Vehicle Speed Sensor (TOSS/VSS) sensor and connector inspection	Decision
A. Key OFF. B. Disconnect TOSS/VSS sensor. C. Check TOSS/VSS sensor and connector terminals for: damaged or pinched wires; wet or corroded terminals; loose, bent, or broken pins; or broken connector housing. Are TOSS/VSS sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 191 FMI 5.

Pin-Point Tests (SPN 191 FMI 5)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- International® Electronic Engine Terminal Test Kit ZTSE4435C
- Digital Multimeter (DMM) ZTSE4357

Test 1 Setup
A. Key OFF. B. Disconnect TOSS/VSS sensor connector. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into TOSS/VSS vehicle harness and leave TOSS/VSS disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between TOSS/VSS vehicle harness pin-1 and known good GND.	1.2 to 1.7 volts
Decision	
Is voltage between 1.2 and 1.7 volts?	Yes: Go to Test 2.
	No: Repair open in TOSS-H circuit. After repairs are complete, retest for SPN 191 FMI 4.

Test 2 Setup
A. Key OFF. B. Disconnect TOSS/VSS sensor connector. C. Using Terminal Test Kit ZTSE4435C, insert correct terminal into TOSS/VSS vehicle harness and leave TOSS/VSS disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between TOSS/VSS vehicle harness pin-2 and known good GND.	1.2 to 1.7 volts
Decision	
Is voltage between 1.2 and 1.7 volts?	Yes: Replace TOSS/VSS sensor. After repairs are complete, retest for SPN 191 FMI 5.
	No: Repair open in TOSS-H circuit. After repairs are complete, retest for SPN 191 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 191 FMI 5 fault code diagnostics.

SPN 191 FMI 14 - TOSS/VSS Error invalid signal

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Invalid vehicle speed value received from Transmission Output Shaft Speed sensor	Output shaft speed as indicated by Transmission Output Shaft Speed sensor > 8032 RPM AND < 8159.875 RPM	Key ON

Fault Overview

Fault code sets when Electronic Control Module (ECM) detects an invalid vehicle speed value from Transmission Output Shaft Speed sensor.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

•

CONTENT
UNDER
DEVELOPMENT

0000305681

VREF (Voltage Reference)

Overview of VREF Sensor Group

SPN	FMI	Description
3509	3	VREF 1 voltage above maximum (page 2026)
3509	4	VREF 1 voltage below minimum (page 2034)
3510	3	VREF 2 voltage above maximum (page 2047)
3510	4	VREF 2 voltage below minimum (page 2052)
3511	3	VREF 3 voltage above maximum (page 2059)
3511	4	VREF 3 voltage below minimum (page 2066)

Overview

Reference voltage (VREF) is a 5 volt reference supplied by Engine Control Module (ECM) to operate engine sensors.

SPN 3509 FMI 3 - VREF 1 voltage above maximum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply voltage 1 above maximum	Sensor supply voltage 1 (VCC_1) > 5.498 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) detects VREF 1 sensor supply voltage is greater than 5.498 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short to PWR in engine harness
- Short to PWR in UVC harness (if equipped with ECB)
- Short to PWR in ETV
- Short to PWR in EBPC

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3509 FMI 3. Is EST DTC list SPN 3509 FMI 3 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3509 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4952
- Digital Multimeter (DMM)

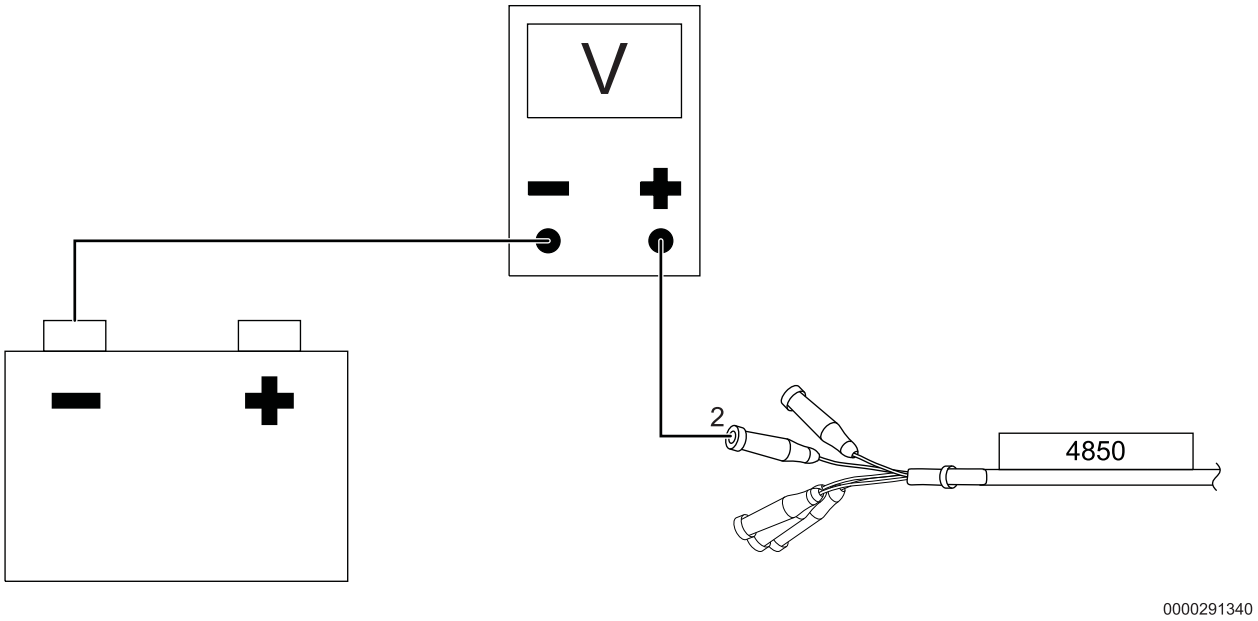


Figure 804 Test 1 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure (EBP) sensor connector. C. Connect breakout harness ZTSE4850 to vehicle harness and reconnect EBP sensor connector. D. Key ON.

Test 1	Measure VREF voltage on EBP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage greater than 5.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

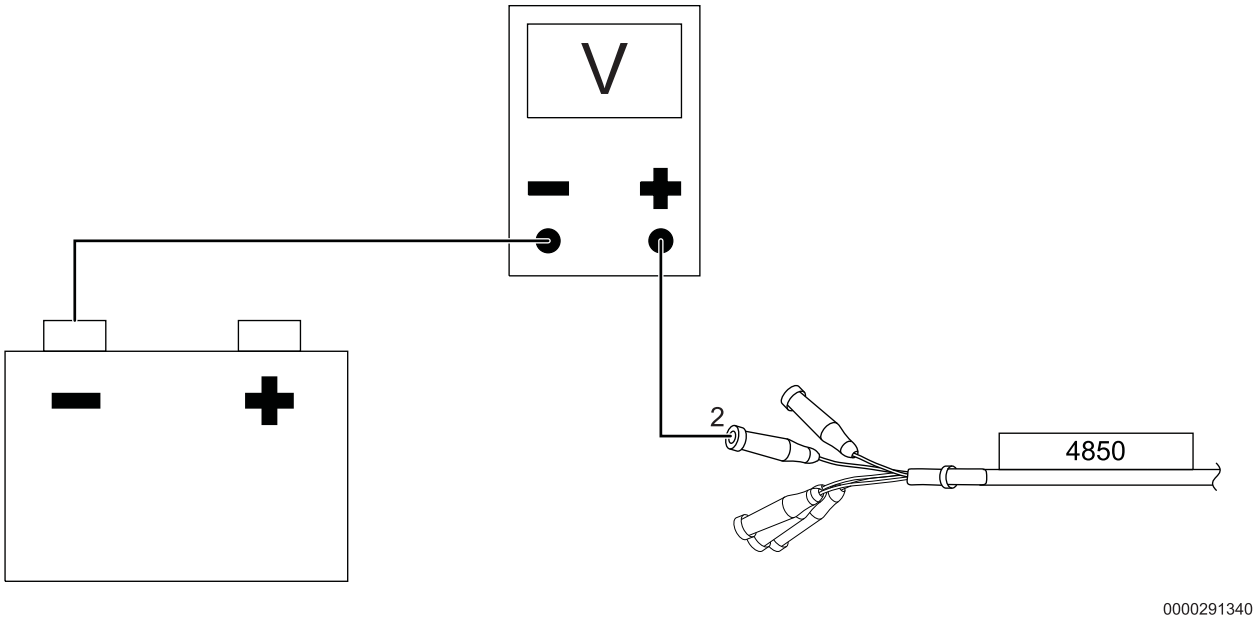


Figure 805 Test 2 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Control Module (ECM) 36-pin driver connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave ECM 36-pin connector disconnected. E. Key ON.

Test 2	Measure VREF voltage on EBP sensor with ECM disconnected.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Go to Test 4.
Is voltage greater than 5.5 volts?		No: Go to Test 3.

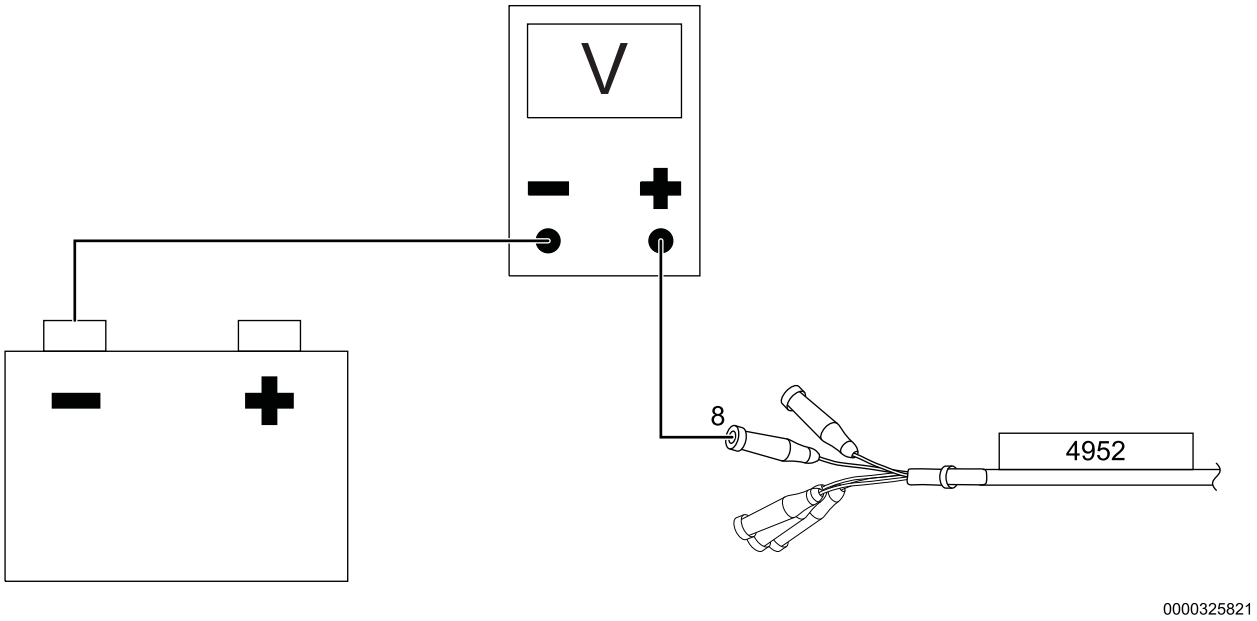


Figure 806 Test 3 Under Valve Connector (UVC) Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Reconnect Engine Control Module (ECM) 36-pin driver connector. C. Disconnect Under Valve Connector (UVC) connector. D. Connect breakout harness ZTSE4952 to vehicle harness and leave UVC connector disconnected. E. Key ON.

Test 3	Measure VREF voltage on UVC.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4952 pin-8 and known good GND.		Yes: Repair engine harness for a Short between ECM pin D-13 and PWR. After repairs are complete, retest for SPN 3509 FMI 3.
Is voltage greater than 5.5 volts?		No: Repair UVC harness for a Short between pin-5 and pin-8 OR pin-5 and pin-3. After repairs are complete, retest for SPN 3509 FMI 3.

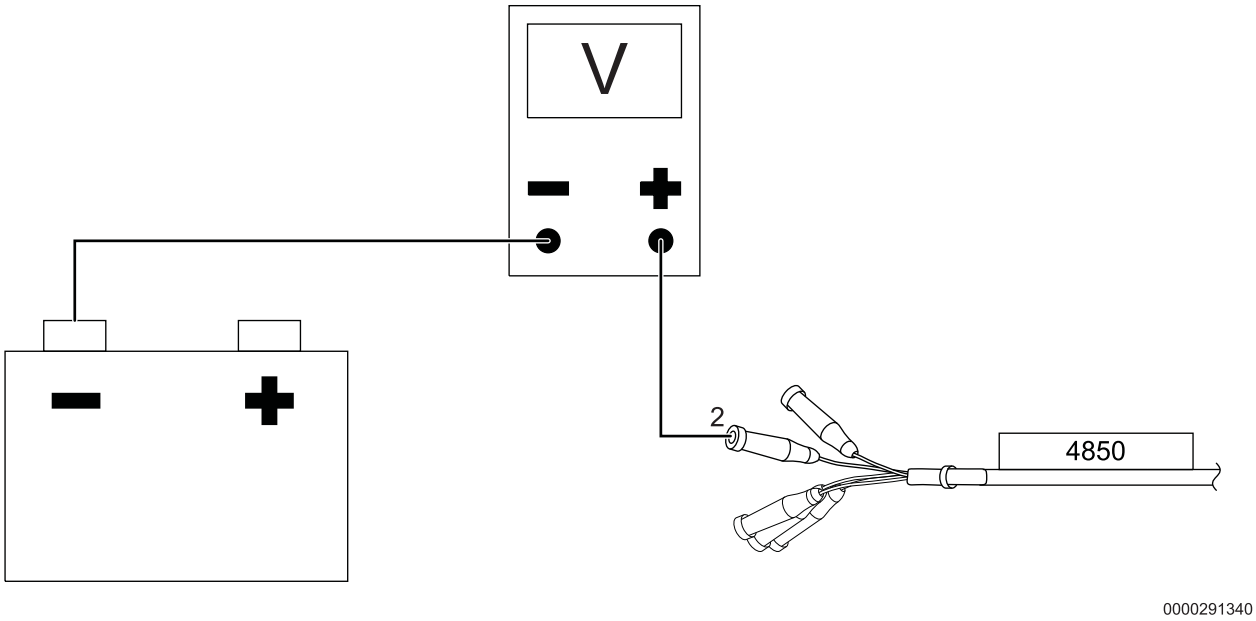


Figure 807 Test 4 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect Turbocharger 1 Turbine Outlet Pressure (TC1TOP) connector. C. Connect breakout harness ZTSE4850 to vehicle harness and leave TC1TOP connector disconnected. D. Key ON.

Test 4	Measure VREF voltage on TC1TOP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Replace TC1TOP sensor. After repairs are complete, retest for SPN 3509 FMI 3.
Is voltage greater than 5.5 volts?		No: Go to Test 5.

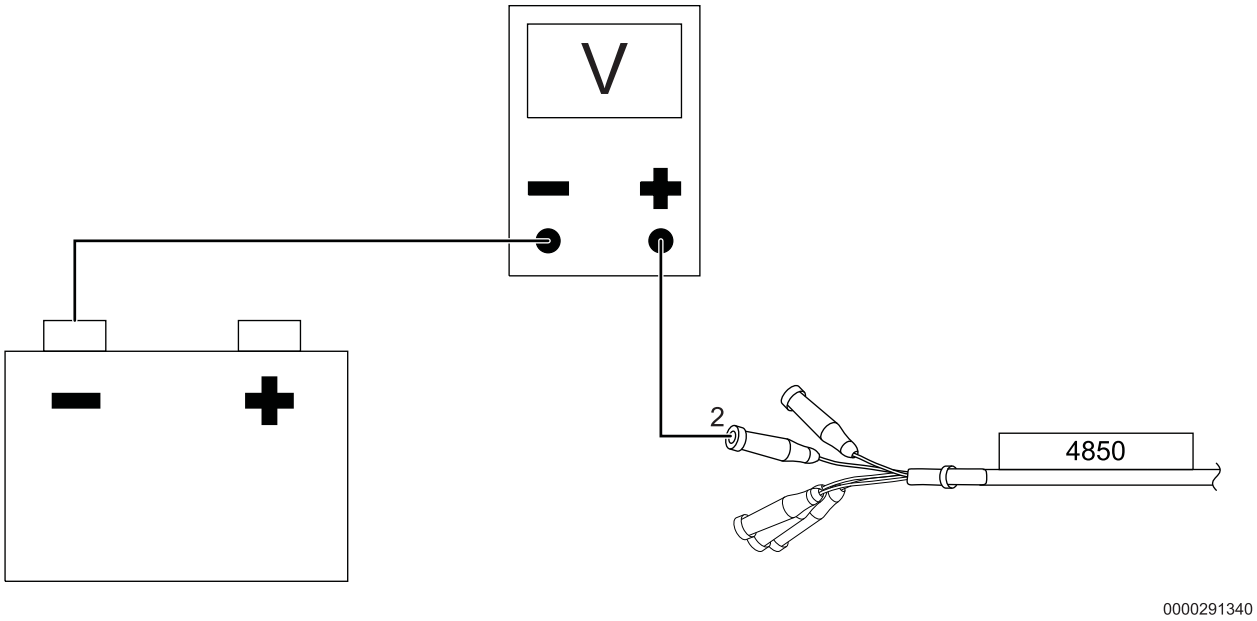


Figure 808 Test 5 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Disconnect Engine Throttle Valve Position (ETP) connector. Reconnect Turbocharger 1 Turbine Outlet Pressure (TC1TOP) connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave ETP connector disconnected. E. Key ON.

Test 5	Measure VREF voltage on TC1TOP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage greater than 5.5 volts?		Yes: Replace ETP sensor. After repairs are complete, retest for SPN 3509 FMI 3. No: Repair Short to PWR in engine harness to pin E-35. After repairs are complete, retest for SPN 3509 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3509 FMI 3 fault code diagnostics.

SPN 3509 FMI 4 - VREF 1 voltage below minimum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply Voltage 1 below minimum	Sensor supply voltage 1 (VCC_1) < 4.502 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) senses VREF 1 sensor supply voltage is less than 4.502 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

Wiring harness routing to all sensors are very important. Make sure that wiring harnesses are routed properly to avoid contact with serpentine belt or pulleys.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short to GND in engine harness
- Short to GND in UVC harness
- Defective ETV
- Defective EBPC
- Defective: EOP, IMP, EBP, FDP, ICP, or BCP (optional) sensors

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3509 FMI 4.		Yes: Perform Pin-Point Tests.
Is EST DTC list SPN 3509 FMI 4 active or pending?		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3509 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4850
- Breakout Harness ZTSE4952

- Digital Multimeter (DMM)

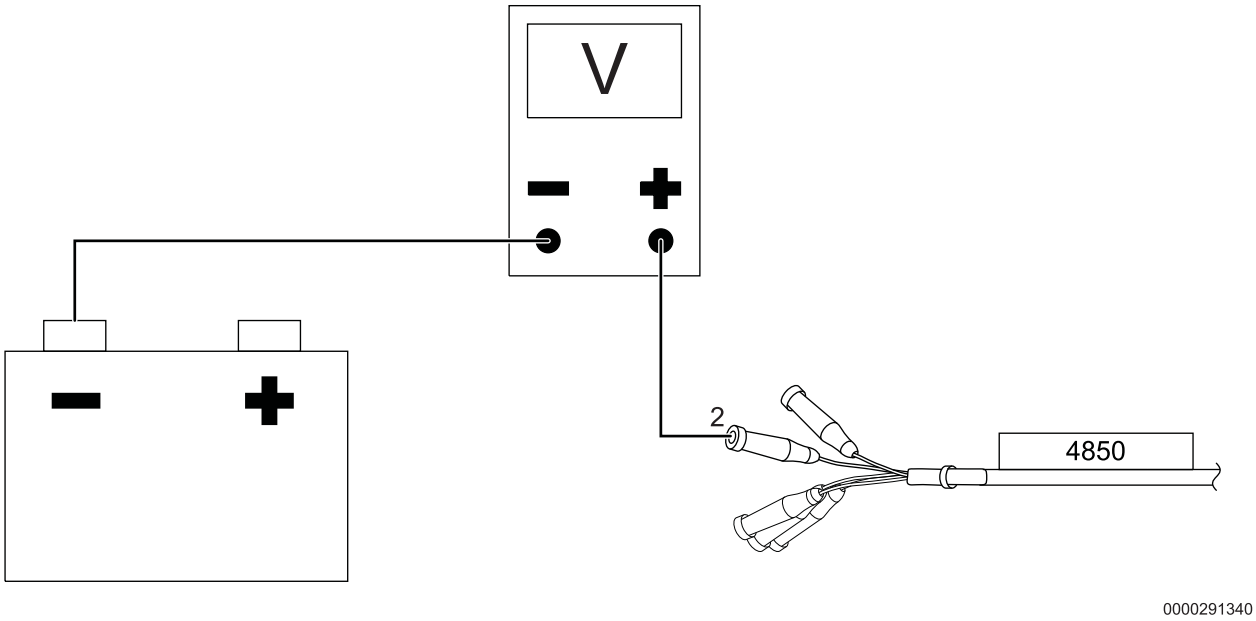


Figure 809 Test 1 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure (EBP) sensor connector. C. Connect breakout harness ZTSE4850 to vehicle harness and reconnect EBP sensor connector. D. Key ON.

Test 1	Measure VREF voltage for EBP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

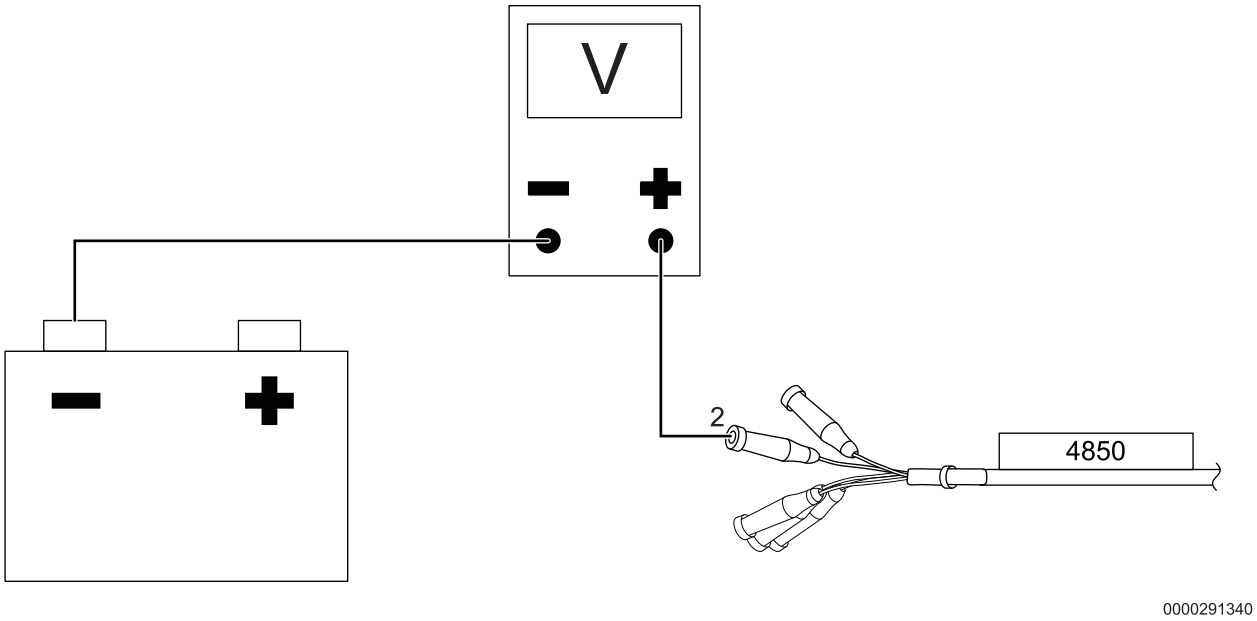


Figure 810 Test 2 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Engine Control Module (ECM) 36-pin driver connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness and reconnect EBP sensor connector. E. Key ON.

Test 2	Measure VREF voltage for EBP sensor with ECM disconnected.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Go to Test 6.
Is voltage less than 4.5 volts?		No: Go to Test 3.

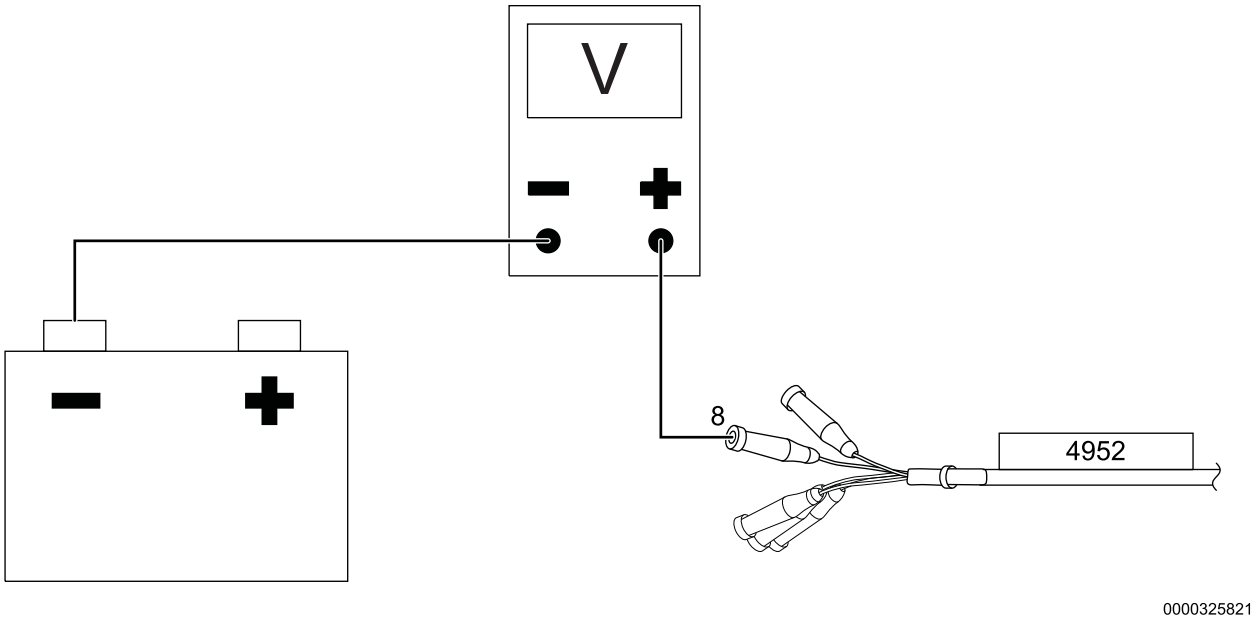


Figure 811 Test 3 Under Valve Connector (UVC) Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Reconnect Engine Control Module (ECM) 36-pin driver connector. C. Disconnect Under Valve Connector (UVC) connector. D. Connect breakout harness ZTSE4952 to vehicle harness and leave UVC connector disconnected. E. Key ON.

Test 3	Measure VREF voltage for UVC.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4952 pin-8 and known good GND.		Yes: Repair engine harness for a Short between ECM pin D-13 and GND. After repairs are complete, retest for SPN 3509 FMI 4.
Is voltage less than 4.5 volts?		No: Go to Test 4.

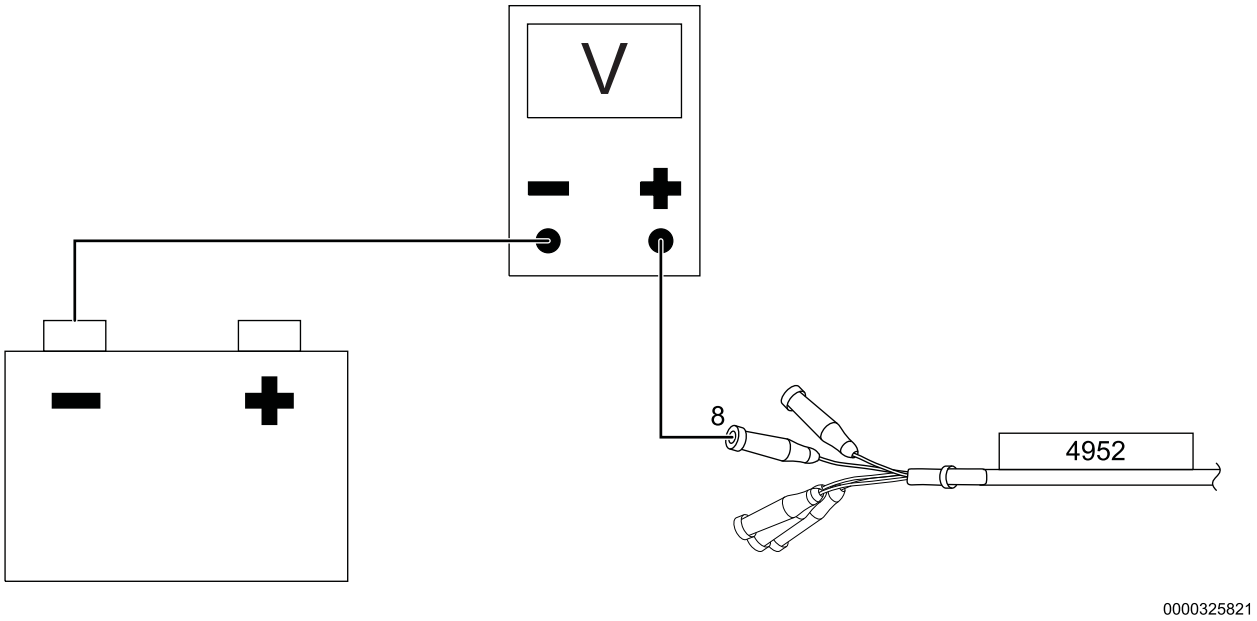


Figure 812 Test 4 Under Valve Connector (UVC) Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Remove valve cover. C. Disconnect Under Valve Connector (UVC) connector. D. Connect breakout harness ZTSE4952 to vehicle harness and leave UVC connector disconnected. E. Disconnect Injection Control Pressure (ICP) connector. F. Key ON.

Test 4	Measure VREF voltage for UVC with ICP disconnected.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4952 pin-8 and known good GND.		Yes: Go to Step 5.
Is voltage less than 4.5 volts?		No: Replace ICP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

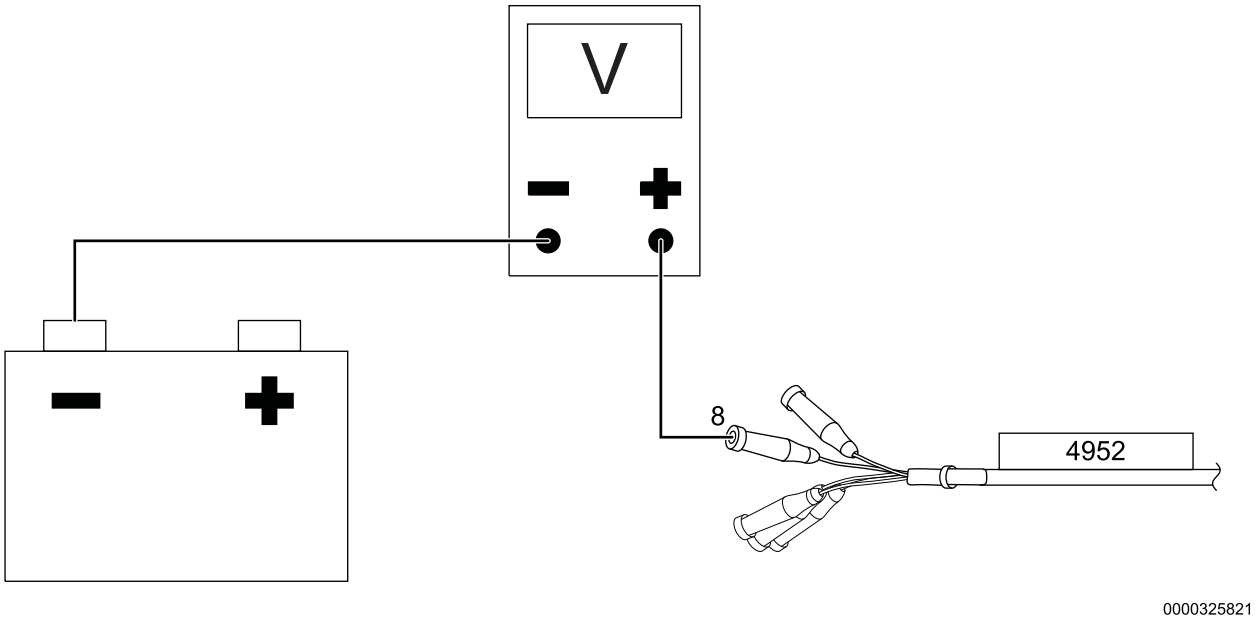


Figure 813 Test 5 Under Valve Connector (UVC) Circuit Voltage Check

Test 5 Setup
A. Key OFF. B. Remove valve cover C. Disconnect Under Valve Connector (UVC) connector. D. Connect breakout harness ZTSE4952 to vehicle harness and leave UVC connector disconnected. E. Reconnect Injection Control Pressure (ICP) connector. Disconnect Brake Control Pressure (BCP) connector. F. Key ON.

Test 5	Measure VREF voltage for UVC with BCP disconnected.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4952 pin-8 and known good GND. Is voltage less than 4.5 volts?		Yes: Repair UVC harness. After repairs are complete, retest for SPN 3509 FMI 4. No: Replace BCP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

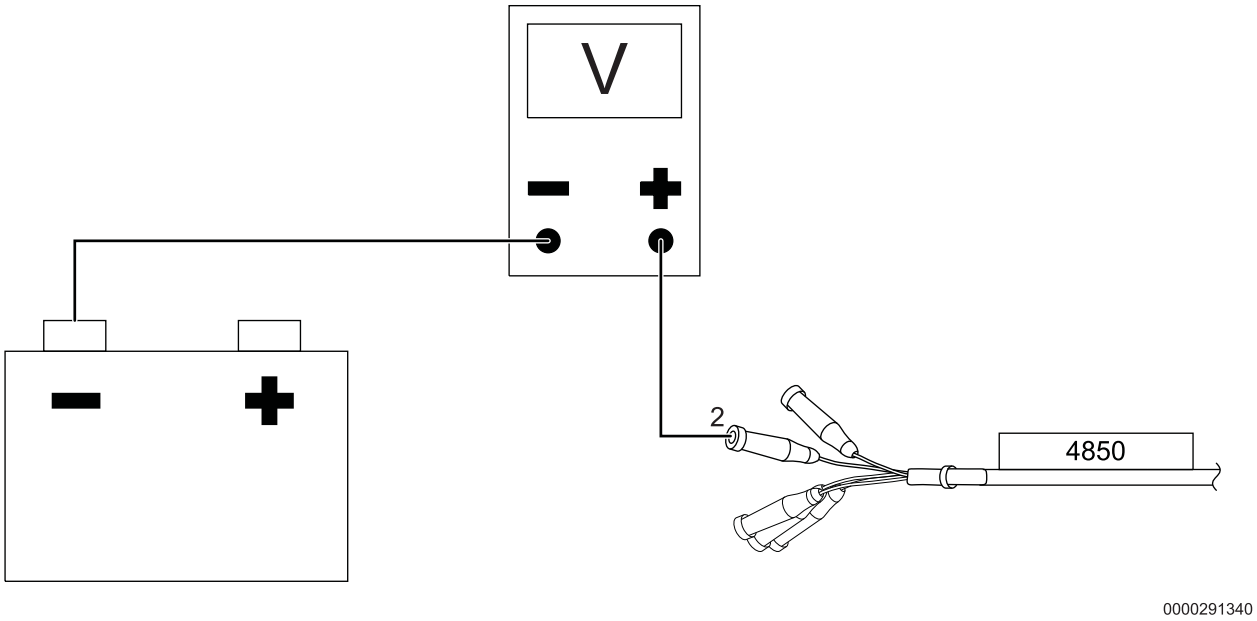


Figure 814 Test 6 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 6 Setup
A. Key OFF. B. Reconnect Brake Control Pressure (BCP) connector. Replace valve cover. C. Disconnect Turbocharger 1 Turbine Outlet Pressure (TC1TOP) connector. D. Disconnect Exhaust Back Pressure (EBP) sensor connector. E. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave TC1TOP disconnected. F. Key ON.

Test 6	Measure VREF voltage for TC1TOP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Go to Step 7.
Is voltage less than 4.5 volts?		No: Replace TC1TOP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

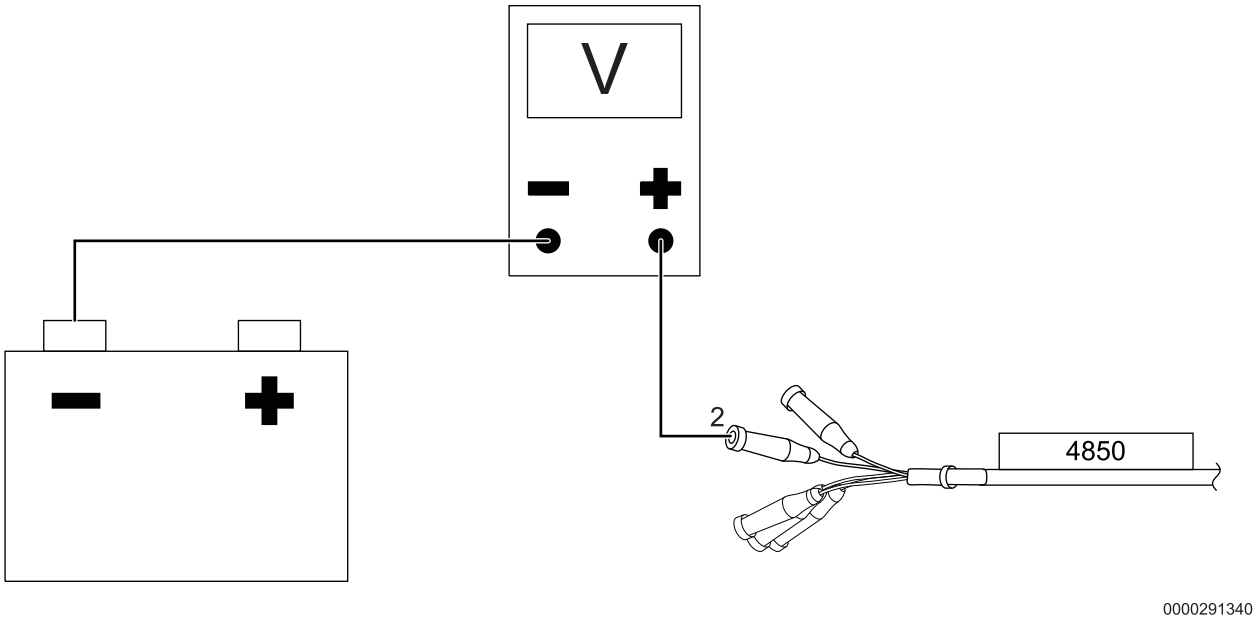


Figure 815 Test 7 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 7 Setup
A. Key OFF. B. Disconnect Engine Throttle Valve Position (ETP) connector. Reconnect Turbocharger 1 Turbine Outlet Pressure (TC1TOP) connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave ETP disconnected. E. Key ON.

Test 7	Measure VREF voltage for ETP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Step 8. No: Replace ETP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

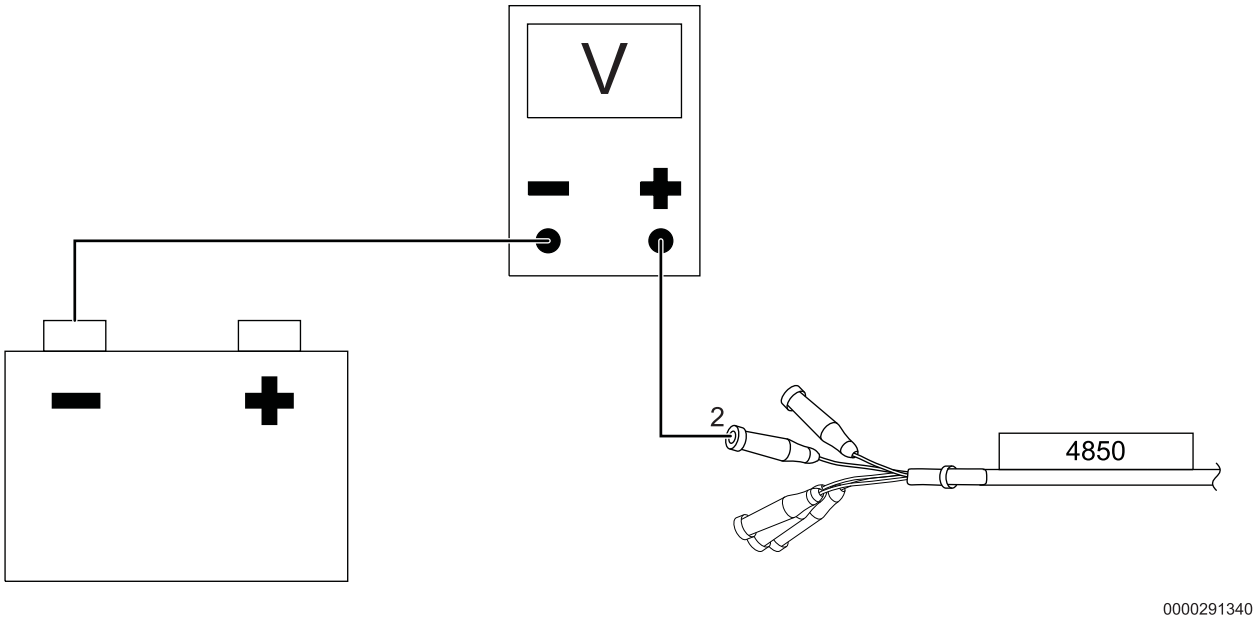


Figure 816 Test 8 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 8 Setup
A. Key OFF. B. Disconnect Fuel Delivery Pressure (FDP) connector. Reconnect Engine Throttle Valve Position (ETP) connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave FDP disconnected. E. Key ON.

Test 8	Measure VREF voltage for FDP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Go to Step 9.
Is voltage less than 4.5 volts?		No: Replace FDP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

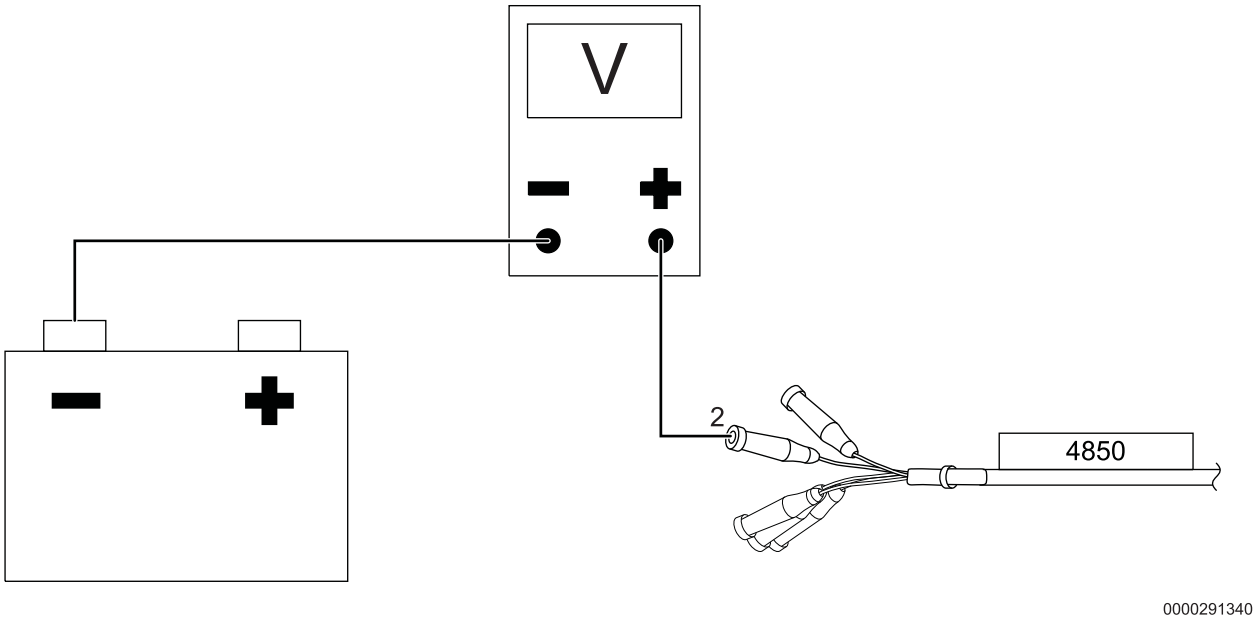


Figure 817 Test 9 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 9 Setup
A. Key OFF. B. Disconnect Engine Oil Pressure (EOP) connector. Reconnect Fuel Delivery Pressure (FDP) connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave EOP disconnected. E. Key ON.

Test 9	Measure VREF voltage for EOP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Step 10. No: Replace EOP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

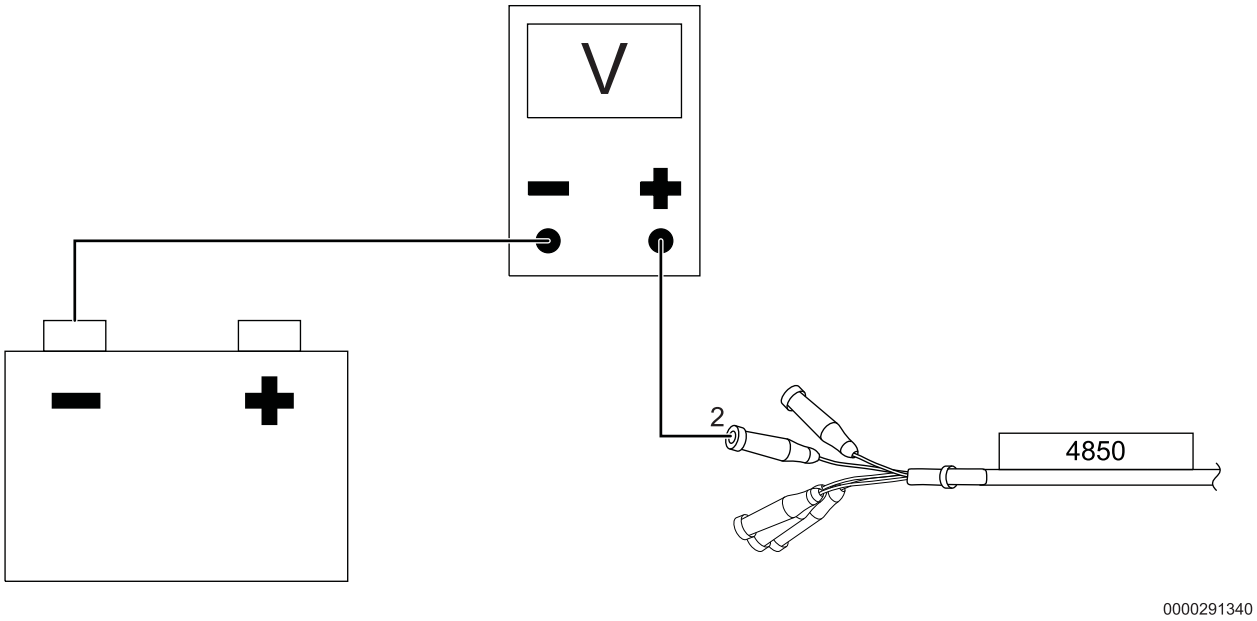


Figure 818 Test 10 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 10 Setup
A. Key OFF. B. Disconnect Intake Manifold Pressure (IMP) connector. Reconnect Engine Oil Pressure (EOP) connector. C. Disconnect Exhaust Back Pressure (EBP) sensor connector. D. Connect breakout harness ZTSE4850 to vehicle harness, reconnect EBP sensor connector, and leave IMP disconnected. E. Key ON.

Test 10	Measure VREF voltage for IMP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND.		Yes: Go to Step 11.
Is voltage less than 4.5 volts?		No: Replace IMP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

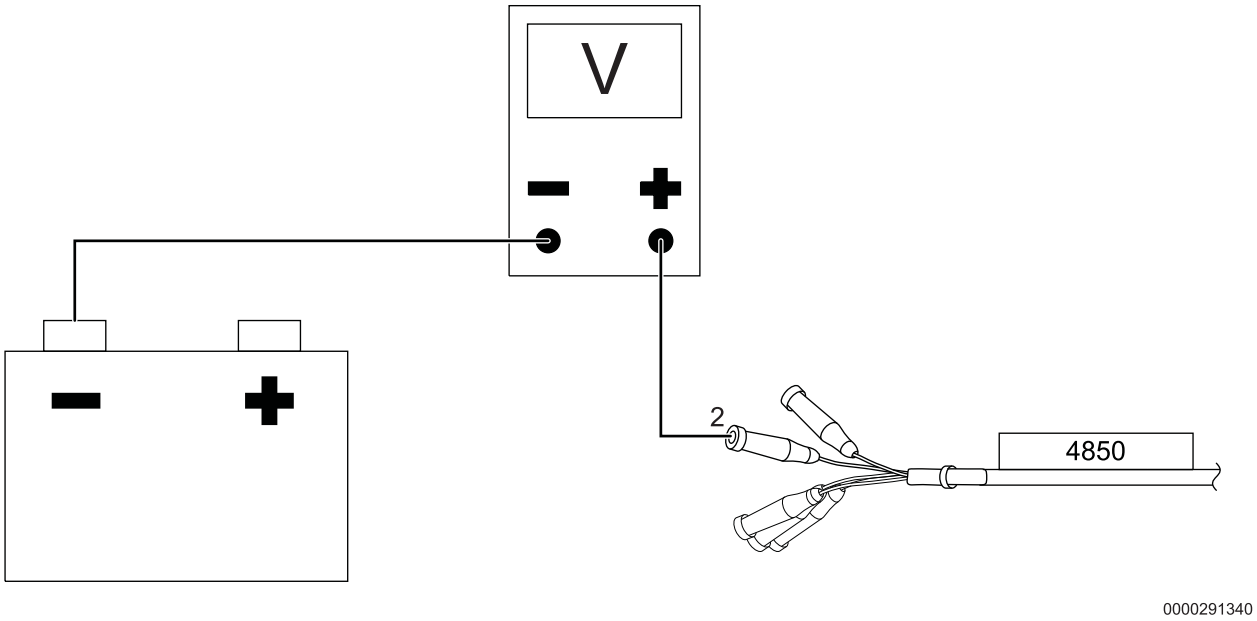


Figure 819 Test 11 Exhaust Back Pressure (EBP) Circuit Voltage Check

Test 11 Setup
A. Key OFF. B. Disconnect Exhaust Back Pressure (EBP) sensor connector. Reconnect Intake Manifold Pressure (IMP) connector. C. Connect breakout harness ZTSE4850 to vehicle harness and leave EBP sensor disconnected. D. Key ON.

Test 11	Measure VREF voltage for EBP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4850 pin-2 and known good GND. Is voltage less than 4.5 volts?		Yes: Repair short to GND in engine harness to Pin E-35. After repairs are complete, retest for SPN 3509 FMI 4. No: Replace EBP sensor. After repairs are complete, retest for SPN 3509 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3509 FMI 4 fault code diagnostics.

SPN 3510 FMI 3 - VREF 2 voltage above maximum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply voltage 2 above maximum	Sensor supply voltage 2 (VCC_2) > 5.498 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) senses VREF 2 sensor supply voltage is greater than 5.498 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short circuit to power
- Failed APP sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3510 FMI 3. Is EST DTC list SPN 3510 FMI 3 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3510 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)

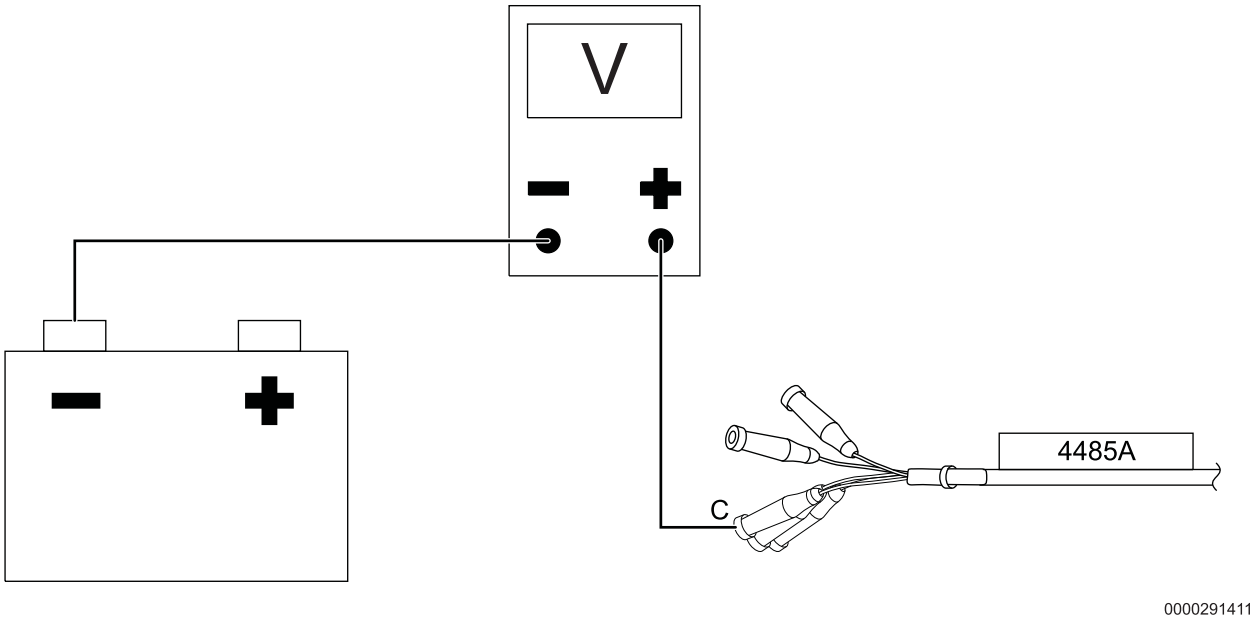


Figure 820 Test 1 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor connector. C. Connect Breakout Harness ZTSE4485A to vehicle harness and reconnect APP connector. D. Key ON.

Test 1	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-C and known good GND. Is voltage greater than 5.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

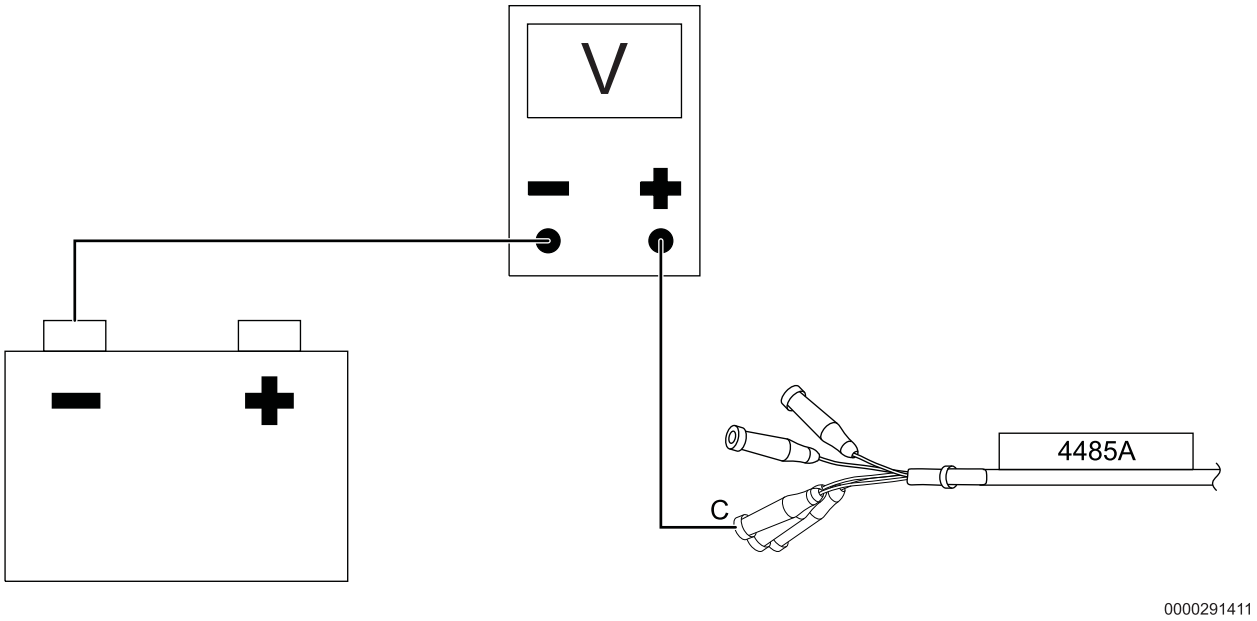


Figure 821 Test 2 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Key ON.

Test 2	Check for short to PWR for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-C and known good GND.		Yes: Repair short to PWR between APP pin-C and Engine Control Module (ECM) pin C-63. After repairs are complete, retest for SPN 3510 FMI 3.
Is voltage greater than 5.5 volts?		No: Replace APP sensor. After repairs are complete, retest for SPN 3510 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3510 FMI 3 fault code diagnostics.

SPN 3510 FMI 4 - VREF 2 voltage below minimum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply Voltage 2 below minimum	Sensor supply voltage 2 (VCC_2) < 4.502 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) senses VREF 2 sensor supply voltage is less than 4.502 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short circuit to GND
- Failed APP sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3510 FMI 4. Is EST DTC list SPN 3510 FMI 4 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3510 FMI 4)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)

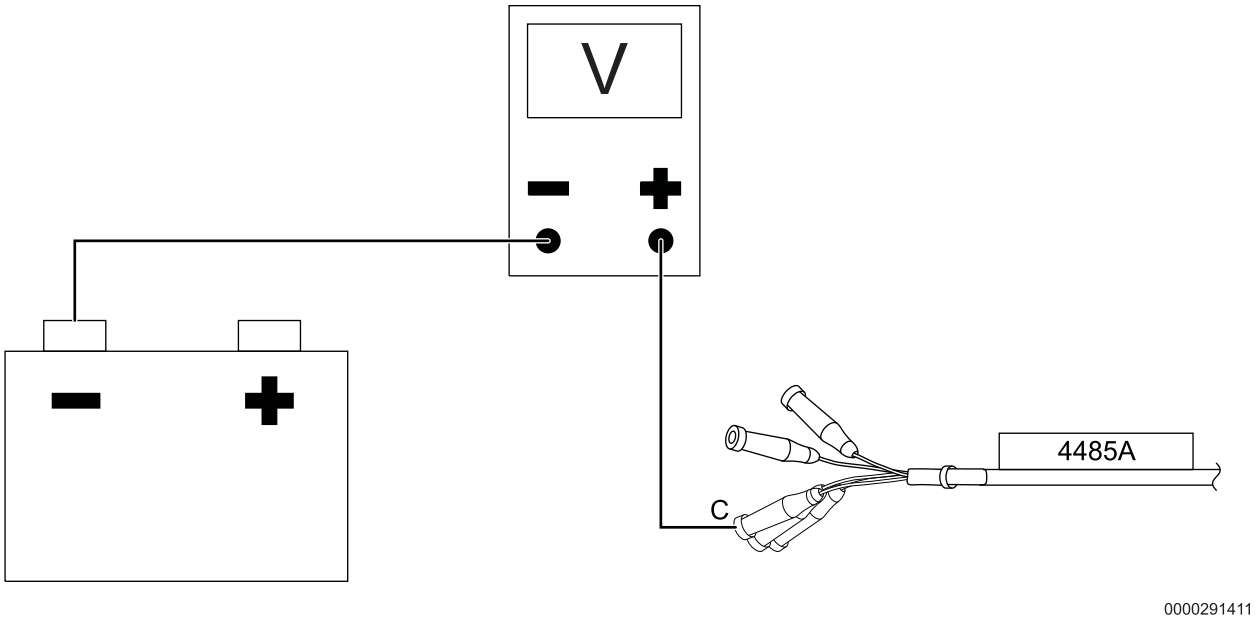


Figure 822 Test 1 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor connector. C. Connect Breakout Harness ZTSE4485A to vehicle harness and reconnect APP connector. D. Key ON.

Test 1	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-C and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

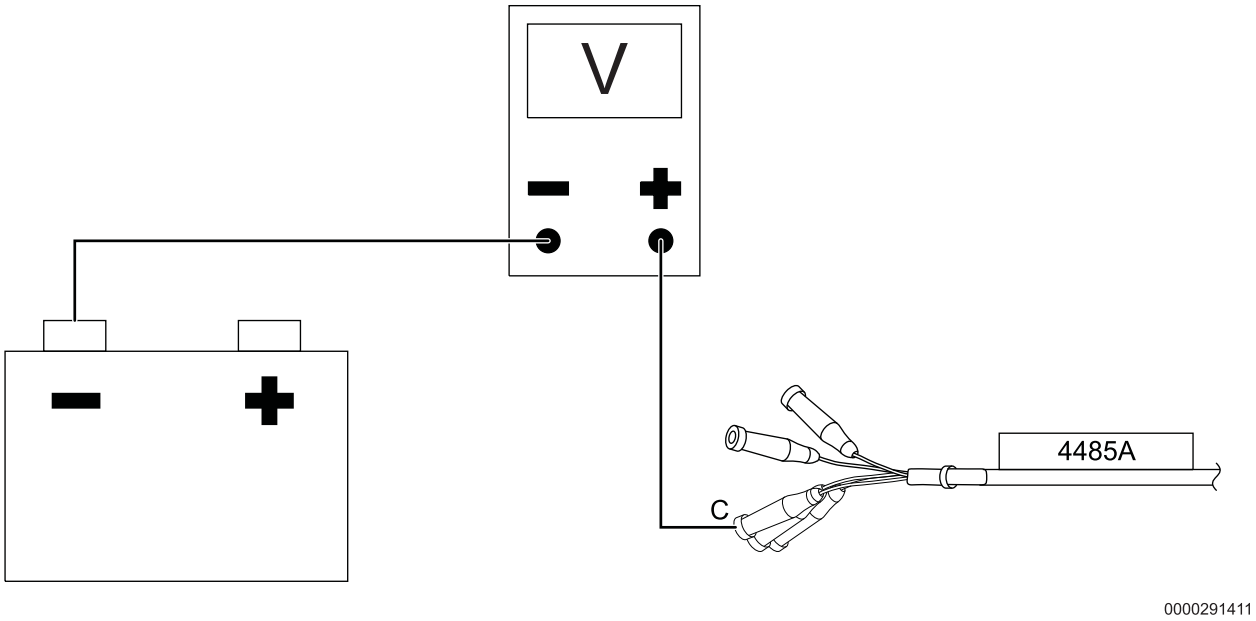


Figure 823 Test 2 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Key ON.

Test 2	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-C and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Test 3. No: Replace APP sensor. After repairs are complete, retest for SPN 3510 FMI 4.

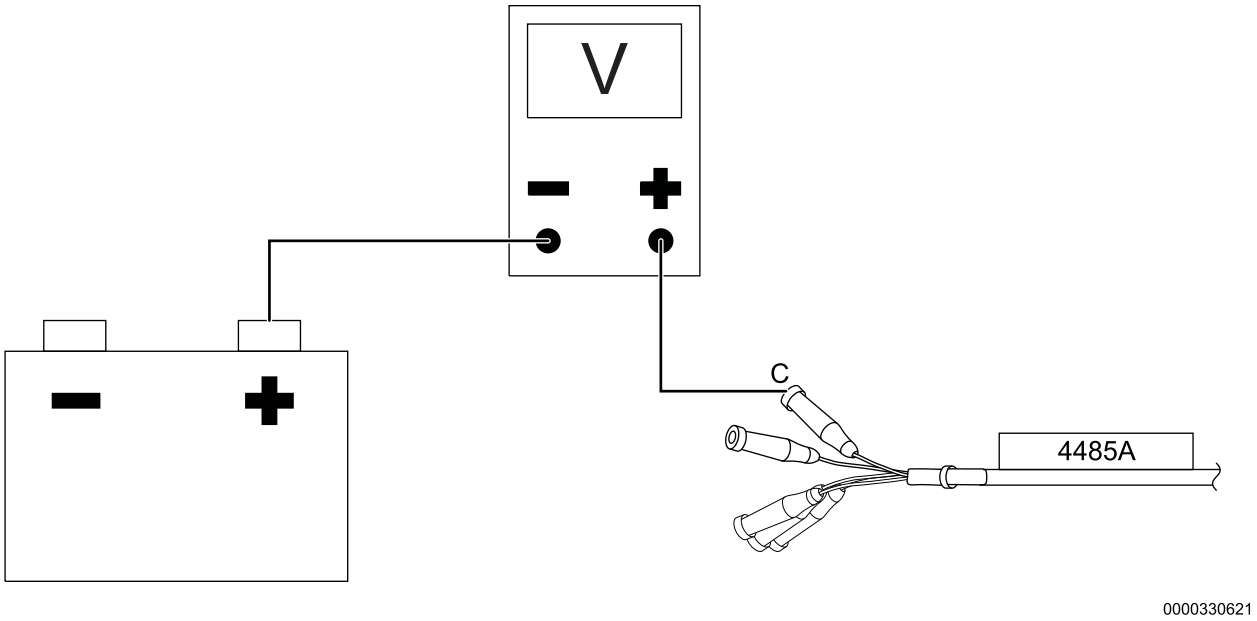


Figure 824 Test 3 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Disconnect 42-pin IP/Engine connector. E. Key ON.

Test 3	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-C and PWR.		Yes: Repair short to GND between APP sensor pin-C and 42-pin connector pin-22. After repairs are complete, retest for SPN 3510 FMI 4.
Is voltage B+ ± 0.5 volts?		No: Repair short to GND between 42-pin connector pin-22 and Engine Control Module (ECM) pin C-63. After repairs are complete, retest for SPN 3510 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3510 FMI 4 fault code diagnostics.

SPN 3511 FMI 3 - VREF 3 voltage above maximum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply voltage 3 above maximum	Sensor supply voltage 3 (VCC_3) > 5.498 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) senses VREF 3 sensor supply voltage is greater than 5.498 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short to PWR in engine harness
- Short to PWR in body builder connection
- Failed Accelerator Pedal Position (APP) sensor

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3511 FMI 3. Is EST DTC list SPN 3511 FMI 3 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3511 FMI 3)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- 42-Pin Engine to Chassis Interface Cable 00-00979-01
- 180-Pin Breakout Box 00-00956-08
- Digital Multimeter (DMM)

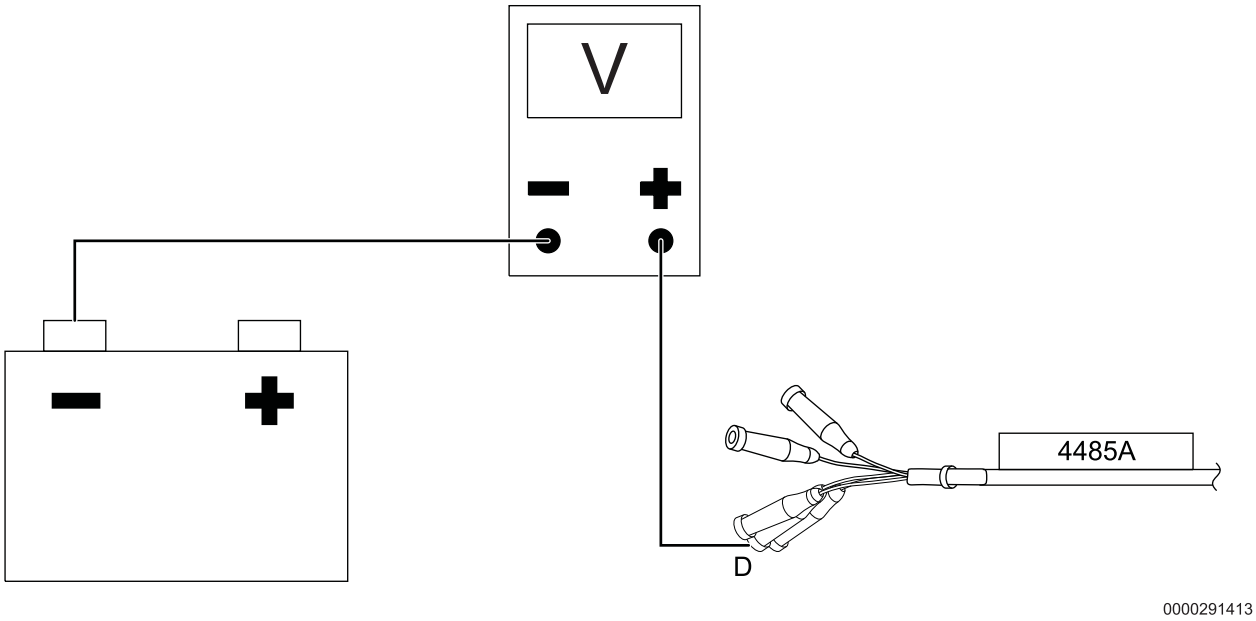


Figure 825 Test 1 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor connector. C. Connect Breakout Harness ZTSE4485A to vehicle harness and reconnect APP connector. D. Key ON.

Test 1	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and known good GND. Is voltage greater than 5.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

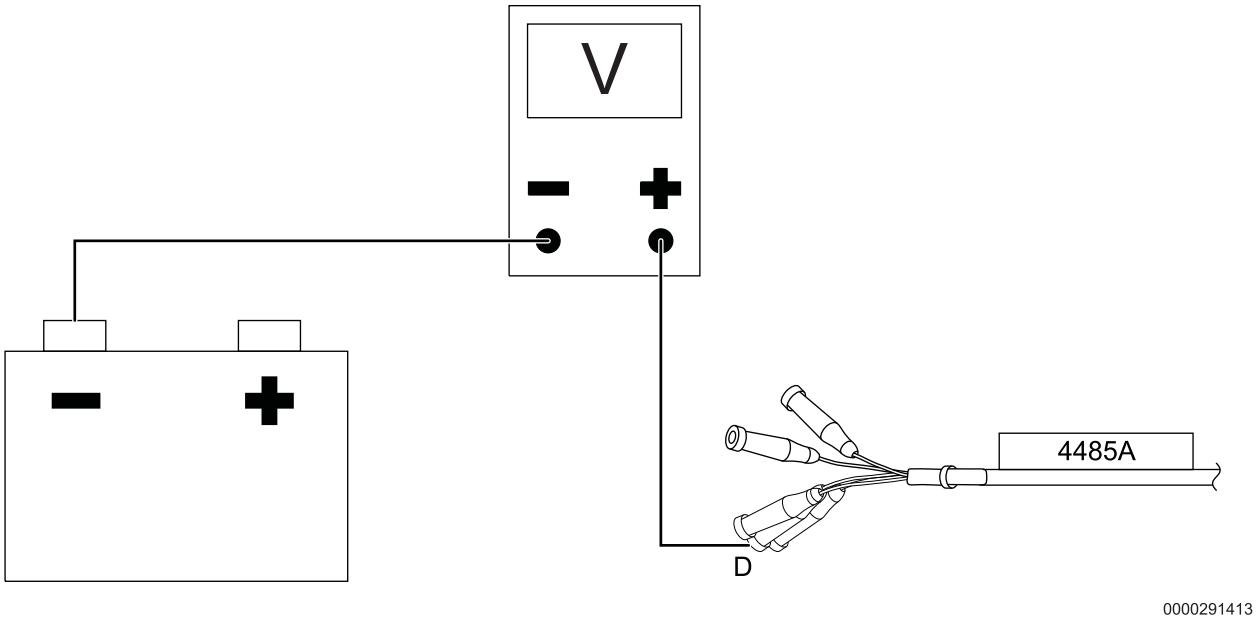


Figure 826 Test 2 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect APP sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Key ON.

Test 2	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and known good GND. Is voltage greater than 5.5 volts?		Yes: Go to Test 3. No: Replace APP sensor. After repairs are complete, retest for SPN 3511 FMI 3.

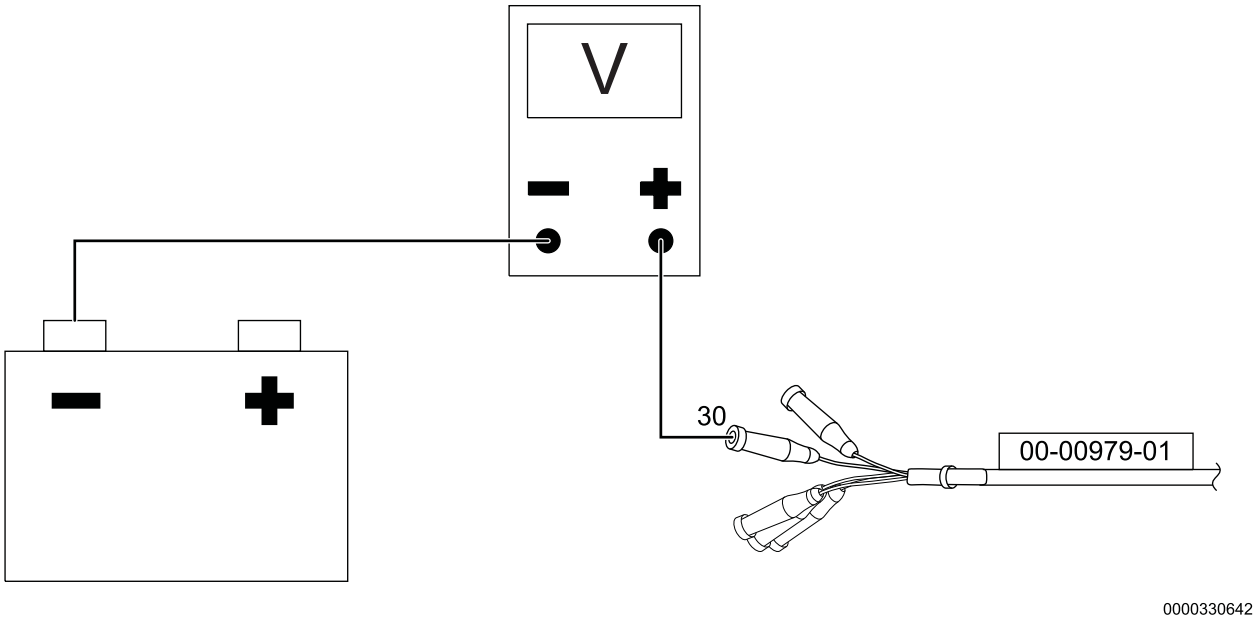


Figure 827 Test 3 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect 42-Pin IP / Engine connector. C. Connect Breakout Box 00-00956-08 to Breakout Harness 00-00979-01. D. Connect Breakout Harness 00-00979-01 to vehicle harness (ECM side of connector) and leave Vehicle side disconnected. E. Disconnect ECM 76-Pin Chassis connector. F. Key ON.

Test 3	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness 00-00979-01 pin-30 and known good GND.		Yes: Repair short to PWR between 42-Pin connector pin-30 and APP pin-D. After repairs are complete, retest for SPN 3511 FMI 3.
Is voltage B+ ± 0.5 volts?		No: Repair short to PWR between ECM pin C-27 and body builder harness. After repairs are complete, retest for SPN 3511 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3511 FMI 3 fault code diagnostics.

SPN 3511 FMI 4 - VREF 3 voltage below minimum

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Sensor supply Voltage 3 below minimum	Sensor supply voltage 3 (VCC_3) < 4.502 Volts	Key ON

Fault Overview

Fault sets when Engine Control Module (ECM) senses VREF 3 sensor supply voltage is less than 4.502 volts.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two consecutive drive cycles.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Short circuit to GND
- Failed APP sensor
- Body builder harness or sensor failure

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 3510 FMI 4. Is EST DTC list SPN 3510 FMI 4 active or pending?		Yes: Perform Pin-Point Tests. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Pin-Point Tests (SPN 3511 FMI 4)

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE4485A
- Digital Multimeter (DMM)

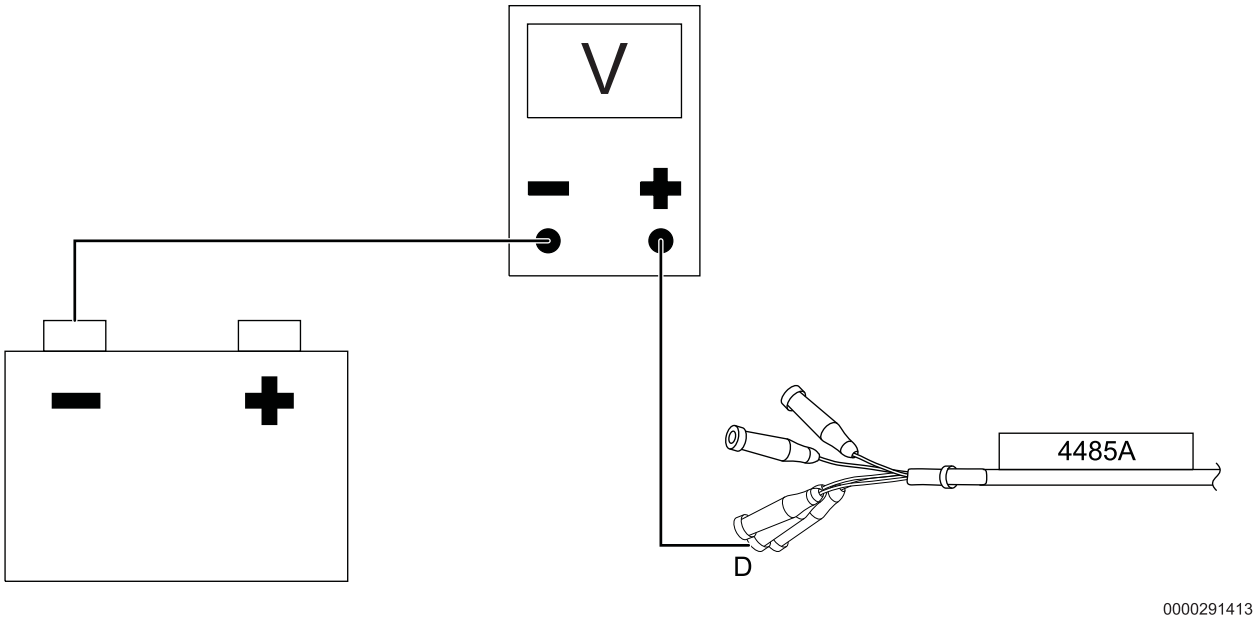


Figure 828 Test 1 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor connector. C. Connect Breakout Harness ZTSE4485A to vehicle harness and reconnect APP connector. D. Key ON.

Test 1	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Test 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

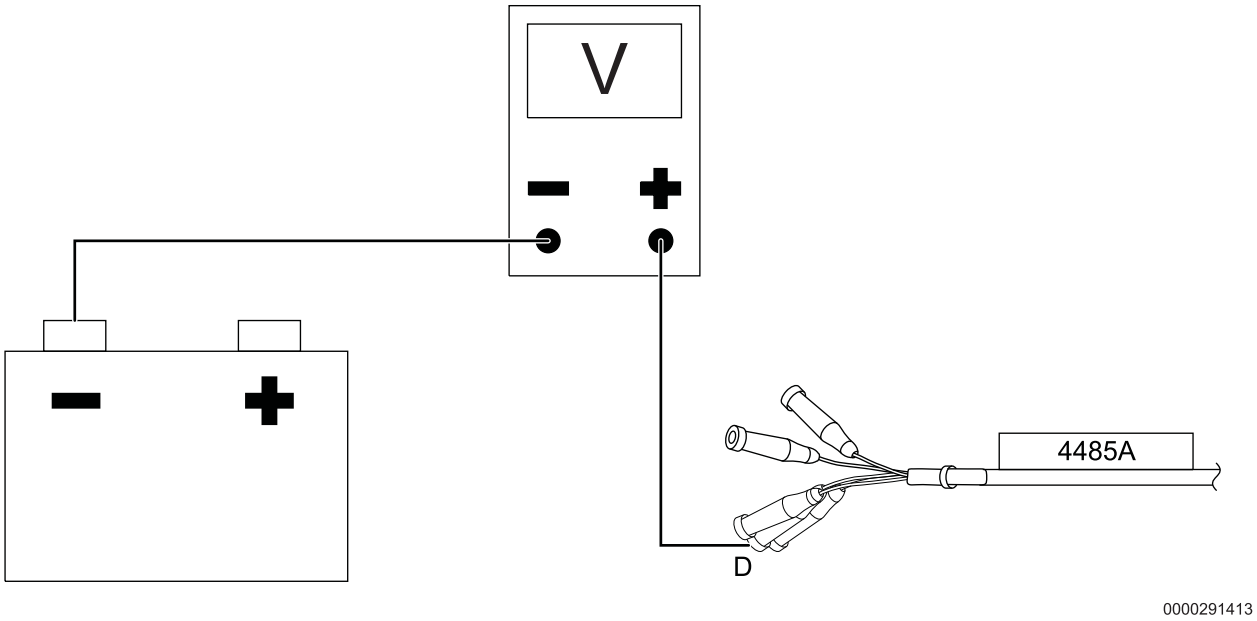


Figure 829 Test 2 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Key ON.

Test 2	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and known good GND. Is voltage less than 4.5 volts?		Yes: Go to Test 3. No: Replace APP sensor. After repairs are complete, retest for SPN 3511 FMI 4.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and known good GND.	B+ ± 0.5 volts
Decision	
Is voltage less than 4.5 volts?	

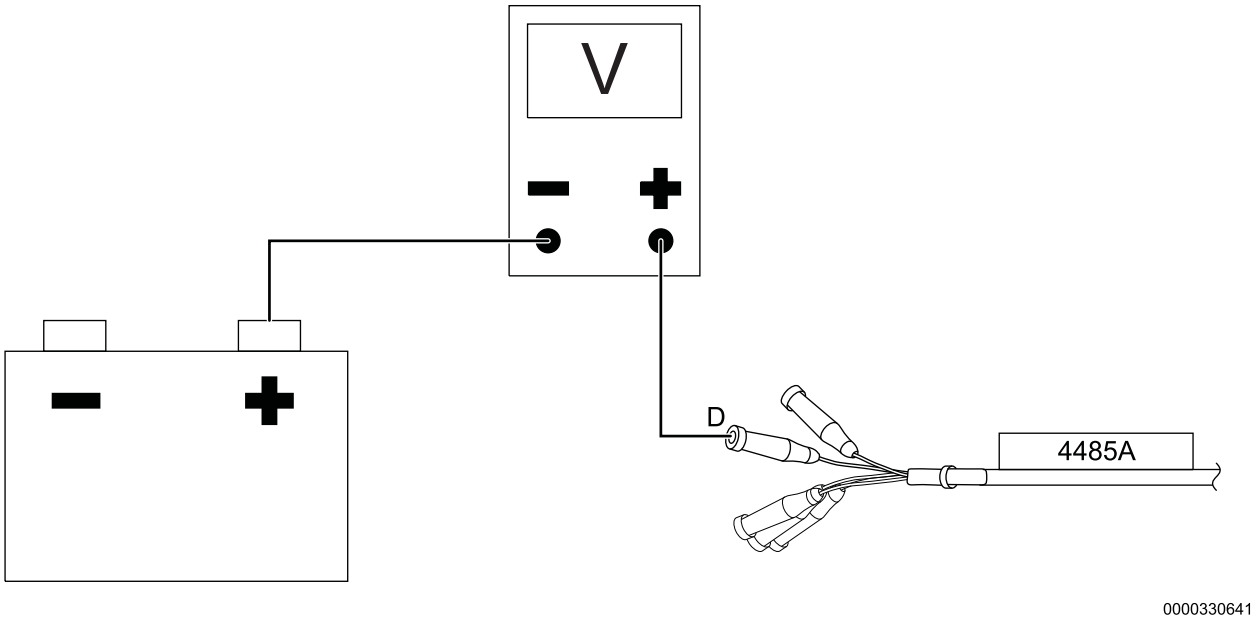


Figure 830 Test 3 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect Accelerator Pedal Position (APP) sensor. C. Connect Breakout Harness ZTSE4485A to vehicle harness and leave APP connector disconnected. D. Disconnect 42-pin IP/Engine connector. E. Key ON.

Test 3	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between Breakout Harness ZTSE4485A pin-D and PWR.		Yes: Repair short to GND between APP sensor pin-D and 42-pin connector pin-30. After repairs are complete, retest for SPN 3511 FMI 4.
Is voltage B+ ± 0.5 volts?		No: Go to Test 4

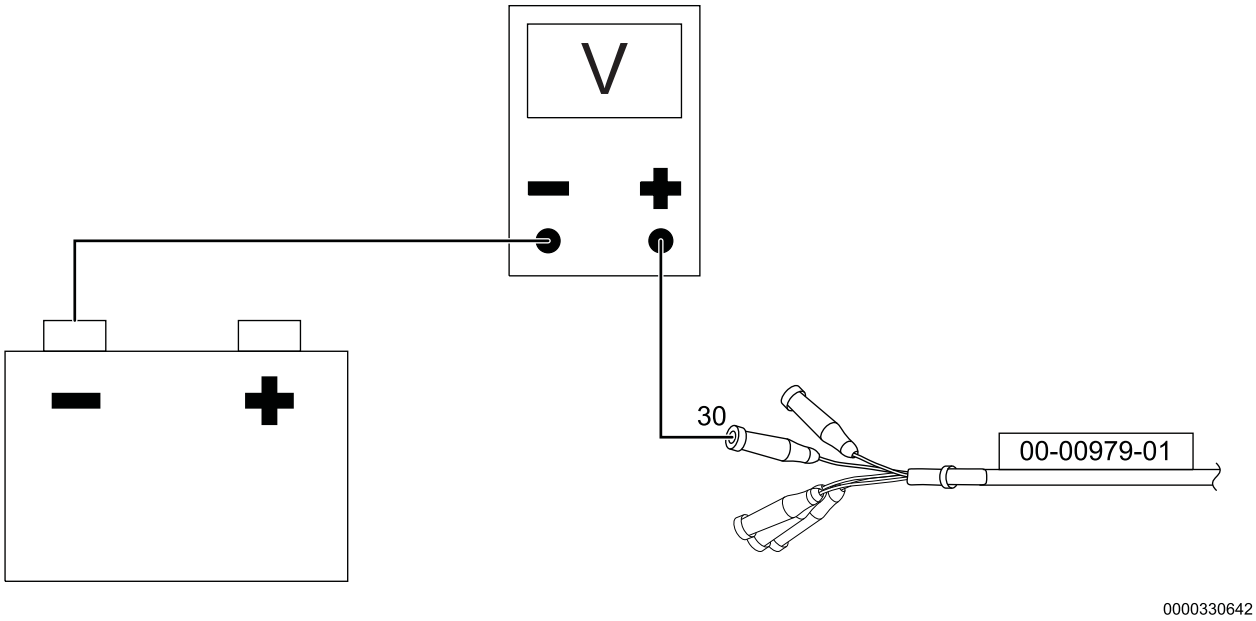


Figure 831 Test 4 Accelerator Pedal Position (APP) Circuit Voltage Check

Test 4 Setup
A. Key OFF. B. Disconnect 42-pin IP/Engine connector between engine and chassis. C. Connect 42-Pin Engine to Chassis Interface Cable 00-00979-01 to vehicle harness (ECM side of connector) and leave 42-Pin IP/Engine connector disconnected. D. Key ON.

Test 4	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between 42-Pin Engine to Chassis Interface Cable 00-00979-01 pin-30 and known good GND.		Yes: Repair short to PWR between 42-Pin connector pin-30 and ECM pin C-9. After repairs are complete, retest for SPN 3511 FMI 4.
Is voltage B+ ± 0.5 volts?		No: Go to Test 5.

Test 5 Setup
A. Key OFF. B. Disconnect 76-pin ECM Chassis connector. C. Disconnect all body builder sensor connections. D. Connect 180-Pin Breakout Box 00-00956-08 to vehicle harness and leave all body builder sensor connections disconnected. E. Key ON.

Test 5	Measure VREF voltage for APP sensor.	Decision
Use DMM to measure voltage between 180-Pin Breakout Box 00-00956-08 pin C-27 and PWR.		Yes: Repair short to GND between pin C-27 and body builder harness. After repairs are complete, retest for SPN 3511 FMI 4.
Is voltage B+ ± 0.5 volts?		No: Replace sensor that shorted VREF3 to GND. After repairs are complete, retest for SPN 3511 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 3511 FMI 4 fault code diagnostics.

WIF Sensor (Water In Fuel)

Overview of WIF Sensor Group

SPN	FMI	Description
4192	3	WIF signal Out of Range HIGH (page 2075)
4192	4	WIF signal Out of Range LOW (page 2079)
4192	5	WIF signal Open or Short to PWR (page 2083)
4192	31	Water in Fuel Detected (page 2089)

Overview

Water In Fuel (WIF) sensor provides a feedback signal to Engine Control Module (ECM) when water is detected in the fuel supply. If water is detected, ECM will alert the operator by illuminating WATER IN FUEL lamp. If a circuit fault is detected, a code will set and ENGINE lamp will illuminate.

SPN 4192 FMI 3 - WIF signal Out of Range HIGH

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Water In Fuel (WIF) signal out of range high.	WIF signal > expected	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Water In Fuel (WIF) signal is greater than expected

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- WIF signal circuit short to PWR
- Failed WIF

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. A. Key ON, clear codes. B. Key OFF, wait for EST screens to clear. C. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4192 FMI 3. Is EST DTC list SPN 4192 FMI 3 active or pending?		Yes: Go to step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Water In Fuel connector inspection.	Decision
Inspect connections at WIF sensor. Key OFF, disconnect WIF sensor. Check WIF sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the WIF sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4192 FMI 3.

Pin-Point Tests SPN 4192 FMI 3

WIF Circuit

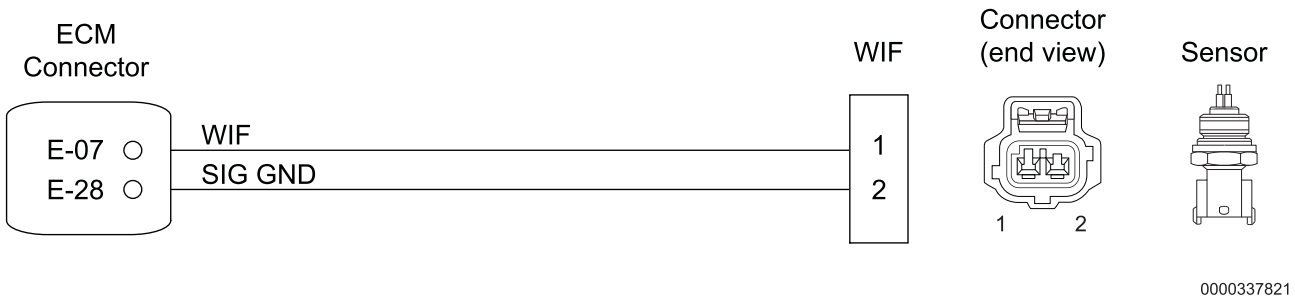


Figure 832 Water In Fuel (WIF) Sensor Circuit

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6002
- Digital Multimeter (DMM)

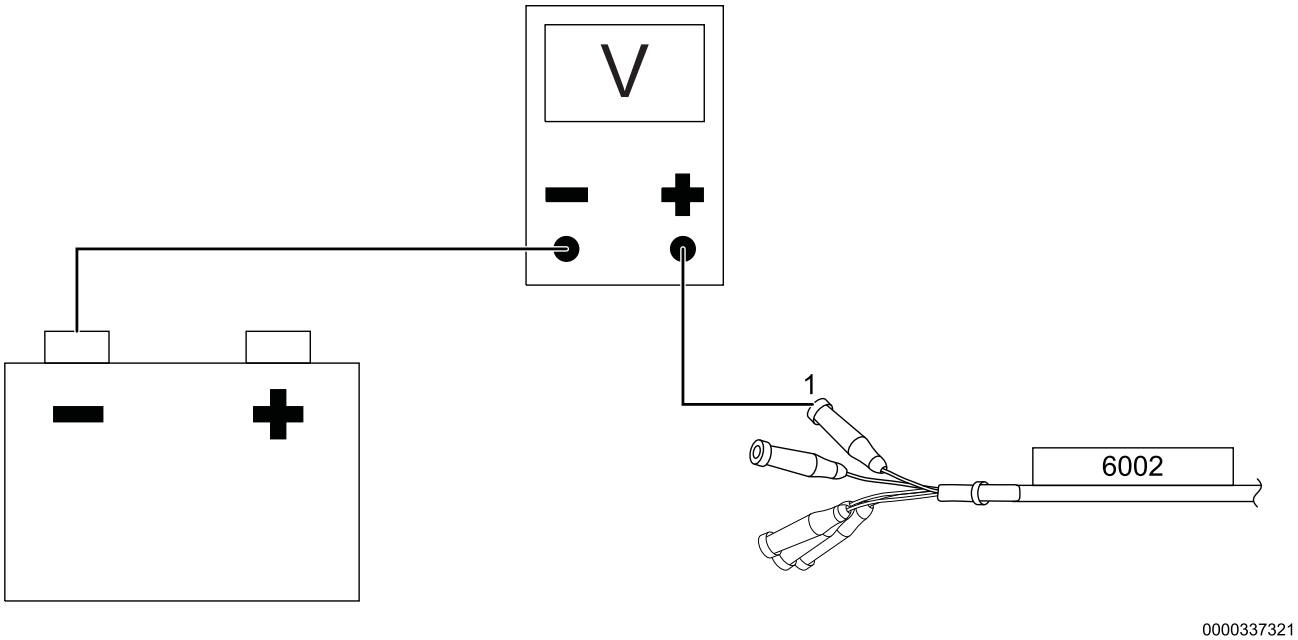


Figure 833 WIF Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Water In Fuel (WIF) sensor connector. C. Connect breakout harness ZTSE6002 to vehicle harness and leave WIF disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6002 pin-1 and known good GND.	Greater than 5.5 volts
Decision	
Is voltage greater than 5.5 volts?	Yes: Repair short to PWR between WIF pin-1 and ECM pin E-7. After repairs are complete, retest for SPN 4192 FMI 3.
	No: Replace WIF sensor. After repairs are complete, retest for SPN 4192 FMI 3.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4192 FMI 3 fault code diagnostics.

SPN 4192 FMI 4 - WIF signal Out of Range LOW

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Water In Fuel (WIF) signal out of range low.	WIF signal < expected	Key ON

Fault Overview

Fault code sets when Engine Control Module (ECM) detects that Water In Fuel (WIF) signal is less than expected

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Poor fuel quality
- WIF circuit short to GND
- Failed WIF

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4192 FMI 4. Is EST DTC list SPN 4192 FMI 4 active or pending?		Yes: Go to step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Check for poor fuel quality	Decision
Perform Fuel Quality Inspection (page 2350). Is fuel free of water, waxing, icing, sediment, gasoline, kerosene, or Diesel Exhaust Fluid (DEF)?		Yes: Go to step 3. No: Drain the fuel tank and fill with new and / or known good diesel fuel. After repairs are complete, retest for SPN 4192 FMI 4

Step 3	Water In Fuel connector inspection.	Decision
Inspect connections at WIF sensor. Key OFF, disconnect WIF sensor. Check WIF sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the WIF sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4192 FMI 4.

Pin-Point Tests SPN 4192 FMI 4

WIF Circuit

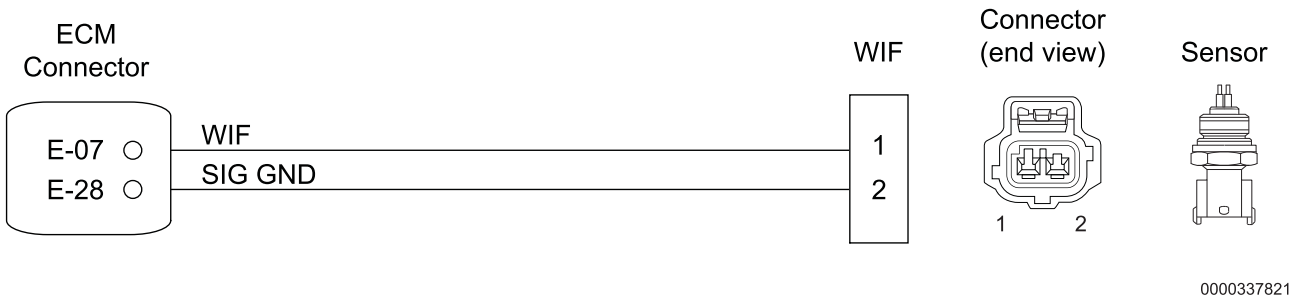
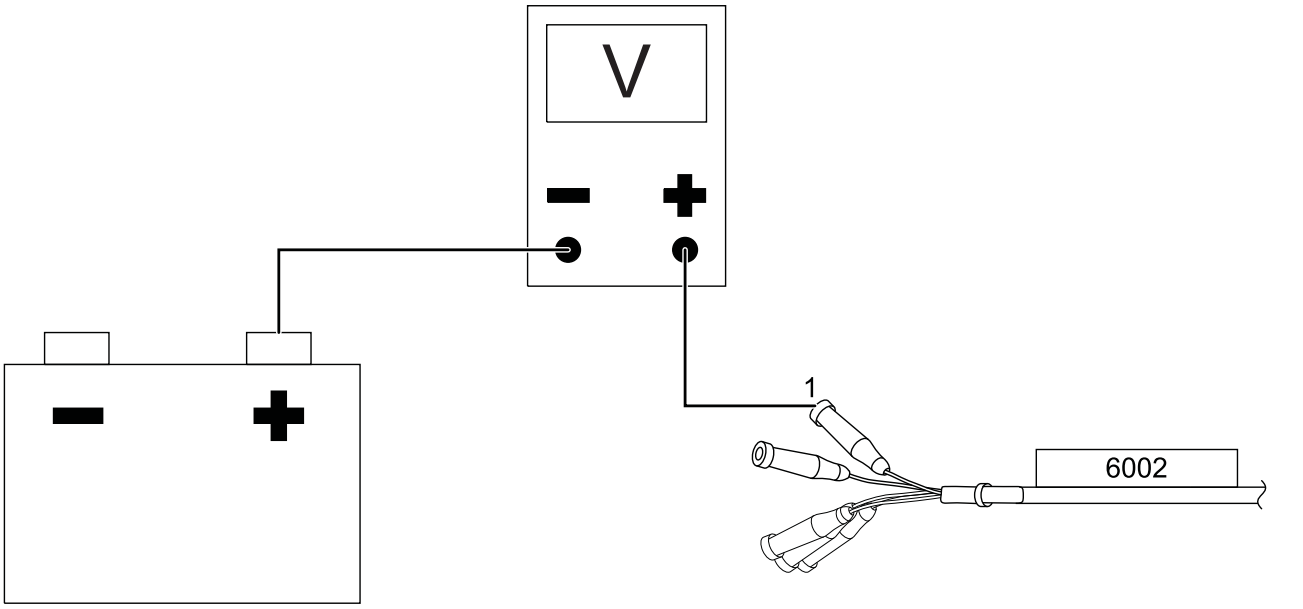


Figure 834 Water In Fuel (WIF) Sensor Circuit

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6002
- Digital Multimeter (DMM)



0000337381

Test 1 Setup
A. Key OFF. B. Disconnect Water In Fuel (WIF) sensor connector. C. Connect breakout harness ZTSE6002 to vehicle harness and leave WIF disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6002 pin-1 and PWR.	B+ ± 0.5 volts
Decision	
Is voltage B+ ± 0.5 volts	Yes: Repair short to GND between WIF pin-1 and ECM pin E-7. After repairs are complete, retest for SPN 4192 FMI 4.
	No: Replace WIF sensor. After repairs are complete, retest for SPN 4192 FMI 4.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4192 FMI 3 fault code diagnostics.

SPN 4192 FMI 5 - WIF signal Open or Short to PWR

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Water In Fuel (WIF) sensor is Not reading as expected.	WIF signal Not reading as expected	Key ON

Fault Overview

Fault code sets when Engine Control Module detects Water In Fuel (WIF) sensor is not reading as expected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

None

Fault Facts

None

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- WIF circuit short to PWR
- WIF circuit Open
- SIG GND circuit Open
- Failed WIF

Step 1	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4192 FMI 3. Is EST DTC list SPN 4192 FMI 3 active or pending?		Yes: Go to step 2. No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 2	Water In Fuel connector inspection.	Decision
Inspect connections at WIF sensor. Key OFF, disconnect WIF sensor. Check WIF sensor and connector terminals for: damaged or pinched wires; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are the WIF sensor connector, harness, and terminals clean and undamaged?		Yes: Perform Pin-Point Tests. No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4192 FMI 5.

Pin-Point Tests SPN 4192 FMI 5

WIF Circuit

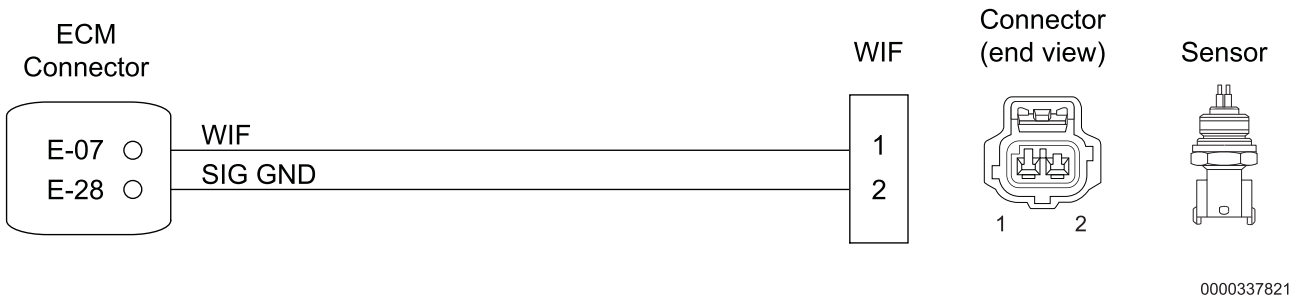


Figure 836 Water In Fuel (WIF) Sensor Circuit

See latest version of Navistar® N9 and N10 SCR Wiring Schematic Form 0000003481 for additional circuit information.

Tools Required

- Breakout Harness ZTSE6002
- Digital Multimeter (DMM)

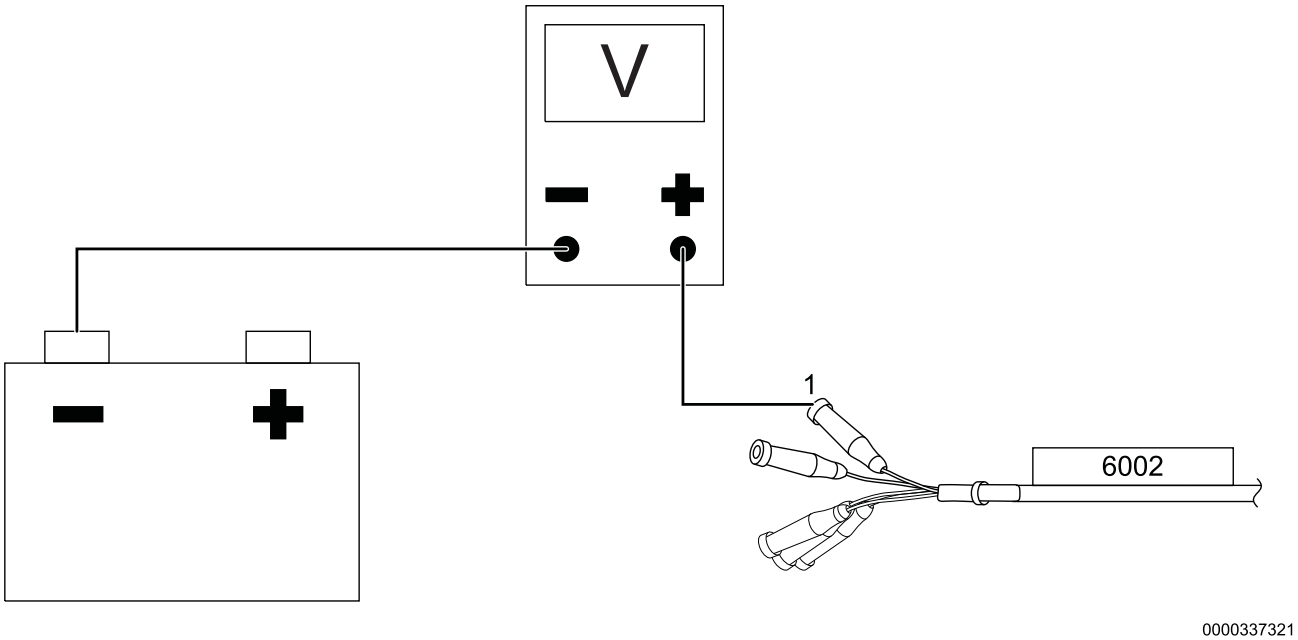
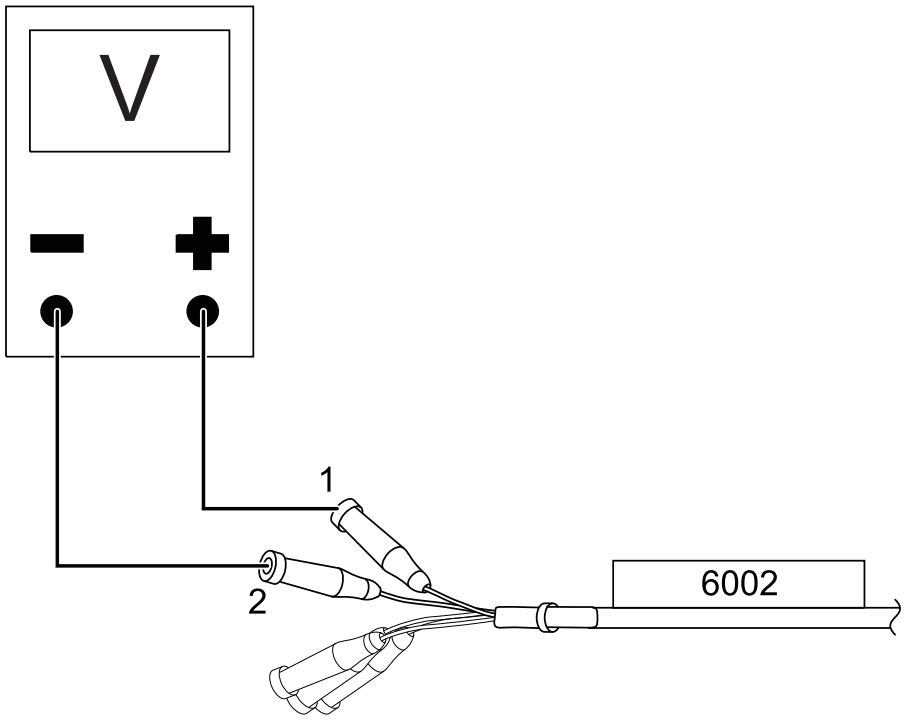


Figure 837 WIF Circuit Voltage Check

Test 1 Setup
A. Key OFF. B. Disconnect Water In Fuel (WIF) sensor connector. C. Connect breakout harness ZTSE6002 to vehicle harness and leave WIF disconnected. D. Key ON.

Test 1	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6002 pin-1 and known good GND.	Greater than 5.5 volts
Decision	
Is voltage greater than 5.5 volts?	Yes: Repair short to PWR between WIF pin-1 and ECM pin E-7. After repairs are complete, retest for SPN 4192 FMI 5.
	No: Go to test 2.



0000338441

Figure 838 WIF Circuit Voltage Check

Test 2 Setup
A. Key OFF. B. Disconnect WIF sensor connector. C. Connect breakout harness ZTSE6002 to vehicle harness and leave WIF disconnected. D. Key ON.

Test 2	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6002 pin-1 and known good GND.	4.5 volts ± 0.5 volts
Decision	
Is voltage 4.5 volts ± 0.5 volts?	Yes: Go to test 3.
	No: Repair Open between WIF pin-1 and ECM pin E-7. After repairs are complete, retest for SPN 4192 FMI 5.

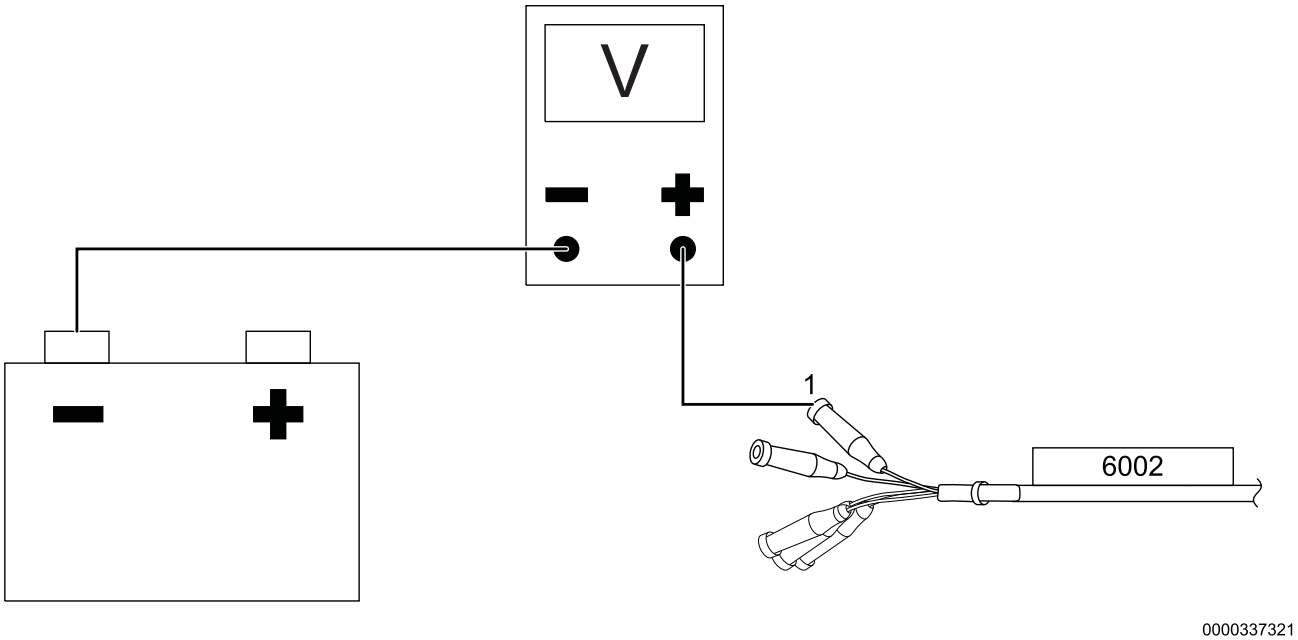


Figure 839 WIF Circuit Voltage Check

Test 3 Setup
A. Key OFF. B. Disconnect WIF sensor connector. C. Connect breakout harness ZTSE6002 to vehicle harness and leave WIF disconnected. D. Key ON.

Test 3	Specification
Use DMM to measure voltage between Breakout Harness ZTSE6002 pin-1 and known good GND.	4.5 volts ± 0.5 volts
Decision	
Is voltage 4.5 volts ± 0.5 volts?	Yes: Replace WIF sensor. After repairs are complete, retest for SPN 4192 FMI 5.
	No: Repair Open between WIF pin-2 and ECM pin E-28. After repairs are complete, retest for SPN 4192 FMI 5.

End Diagnostic Tests
After performing all tests, if no problem is found, verify if each step was completed correctly and the proper decision was made. Return to SPN 4192 FMI 5 fault code diagnostics.

SPN 4192 FMI 31 - Water in Fuel Detected

Condition / Description	Setting Criteria	Enable Conditions / Condition Values
Water in Fuel Detected	WIF sensor signal < 4 volts	Key ON Inactive: SPN 4192 FMI 3, 4, and 5.

Fault Overview

Fault sets when Engine Control Module (ECM) receives indication water in fuel is detected.

Lamp Reaction

Malfunction Indicator Lamp (MIL) will illuminate when this fault is detected during two trips.

Associated Faults

SPN 4192 FMI 3, 4, and 5 (WIF)			

Fault Facts

Water In Fuel (WIF) lamp will illuminate.

Drive Cycle to Determine Fault Status

Continuous

Possible Causes

- Water detected in primary fuel filter housing.

Step 1	Check for associated fault codes.	Decision
Using EST with ServiceMaxx™ software, check DTC list for Associated Faults(page 2089). Is EST DTC list free of Associated Faults?		Yes: Go to Step 2.
		No: Repair Associated Faults. After repairs are complete, retest for SPN 4192 FMI 31.

Step 2	Check for active or pending fault codes.	Decision
Using Electronic Service Tool (EST) with ServiceMaxx™ software. Key ON, check Diagnostic Trouble Code (DTC) list for SPN 4192 FMI 31. Is EST DTC list SPN 4192 FMI 31 active or pending?		Yes: Go to Step 3.
		No: Go to Intermittent or Inactive Fault Diagnostic Procedure (page 2123).

Step 3	Water In Fuel (WIF) sensor and connector inspection.	Decision
A. Key OFF B. Disconnect WIF C. Check WIF and connector terminals for: damaged or pinched wires; moisture in terminals; corroded terminals; loose, bent, or broken pins; or broken connector housing. Are WIF connector, harness, and terminals clean and undamaged?		Yes: Drain water from primary fuel filter. After repairs are complete, retest for SPN 4192 FMI 31.
		No: Repair connector, harness, or terminal damage. After repairs are complete, retest for SPN 4192 FMI 31.

End Diagnostic Steps
After performing all tests, if no problem is found, verify if each step was completed correctly and proper decision was made. Return to SPN 4192 FMI 31 fault code diagnostics.

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How To Use This Section

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ServiceMaxx™ Software Procedures

ServiceMaxx™ Connection and Data Recording

Overview

ServiceMaxx™ is an Engine Electronic Control System Diagnostic Tool. It is used to run Service Bay Test, Procedures and Program engine features. It can also monitor and record signals from the Engine Control Module (ECM), Doser Control Unit (DCU), and Aftertreatment Control Module (ACM).

Engine Auto-Detection

Pre 2007 engines can only Auto-Detect at Key-On Engine-Off (KOEO). The N9-N10 Selective Catalytic Reduction (SCR) engine is able to auto-connect at KOEO or engine running. The only difference when connecting with a running engine is most of the parameters will not load. You will notice lot of missing values in the Vehicle Information window.

Connection (Sniffer)

This area will display all the modules communicating on the Public Controller Area Network (CAN) Network.

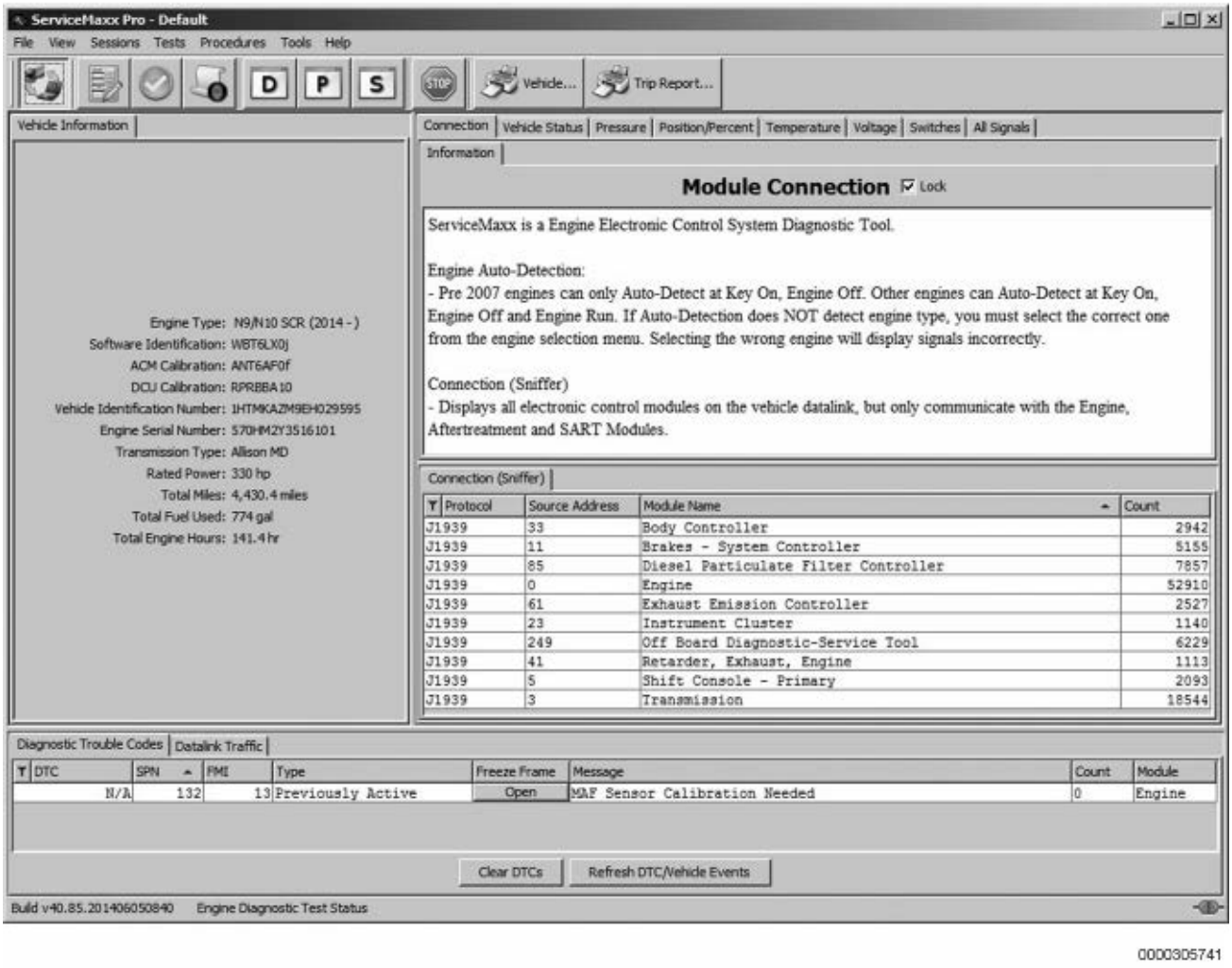
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup



0000305741

Figure 841 ServiceMaxx™ Home Screen

1. Key-On Engine-Off (KOEO) will load signals and parameters.
2. Key-On Engine-Running (KOER) will load signals, but will not load parameters.
3. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector .
4. Start ServiceMaxx™ software.

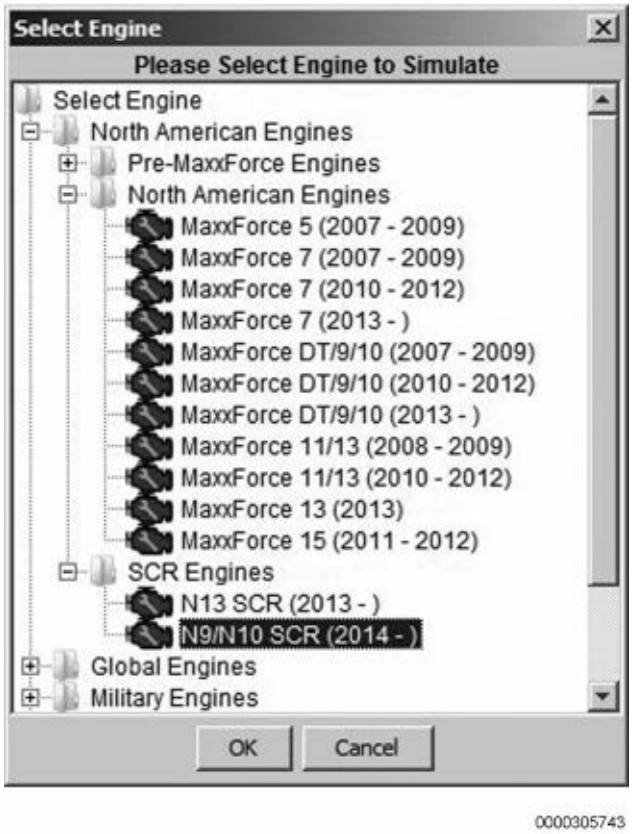


Figure 842 Engine Selection Window

NOTE: If ServiceMaxx™ displays the Engine selection window (Figure 842), it was unable to Auto- Detect. The Engine Control Module (ECM) or the Public Controller Area Network (CAN) to the Data Link connector maybe at fault.

Test Procedure

Snapshot Recording Procedure:



Figure 843 Start Signal Recording

1. Click on the Start Logging Watched Signals button (Figure 843).



Figure 844 Stop Signal Recording

2. Click on the Stop Logging Watched Signals button (Figure 844) to stop the recording.



Figure 845 Snapshot folder

3. Snapshot recording will be saved in the Snapshot folder (Figure 845) located on your computers desktop.

Snapshot Playback Procedure

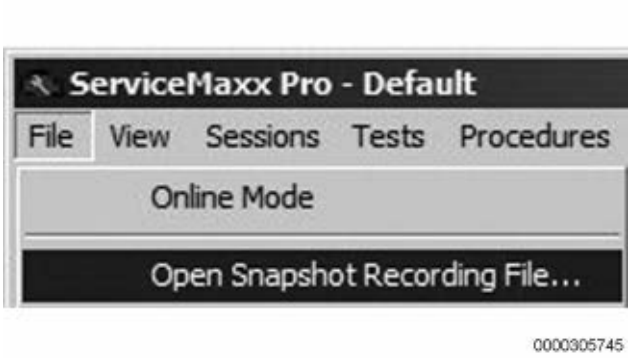


Figure 846 Snapshot

1. Open previously recorded snapshot, Click on the Open Snapshot Recording File (Figure 846) from the File Menu.
2. Select the desired recording you wish to open.

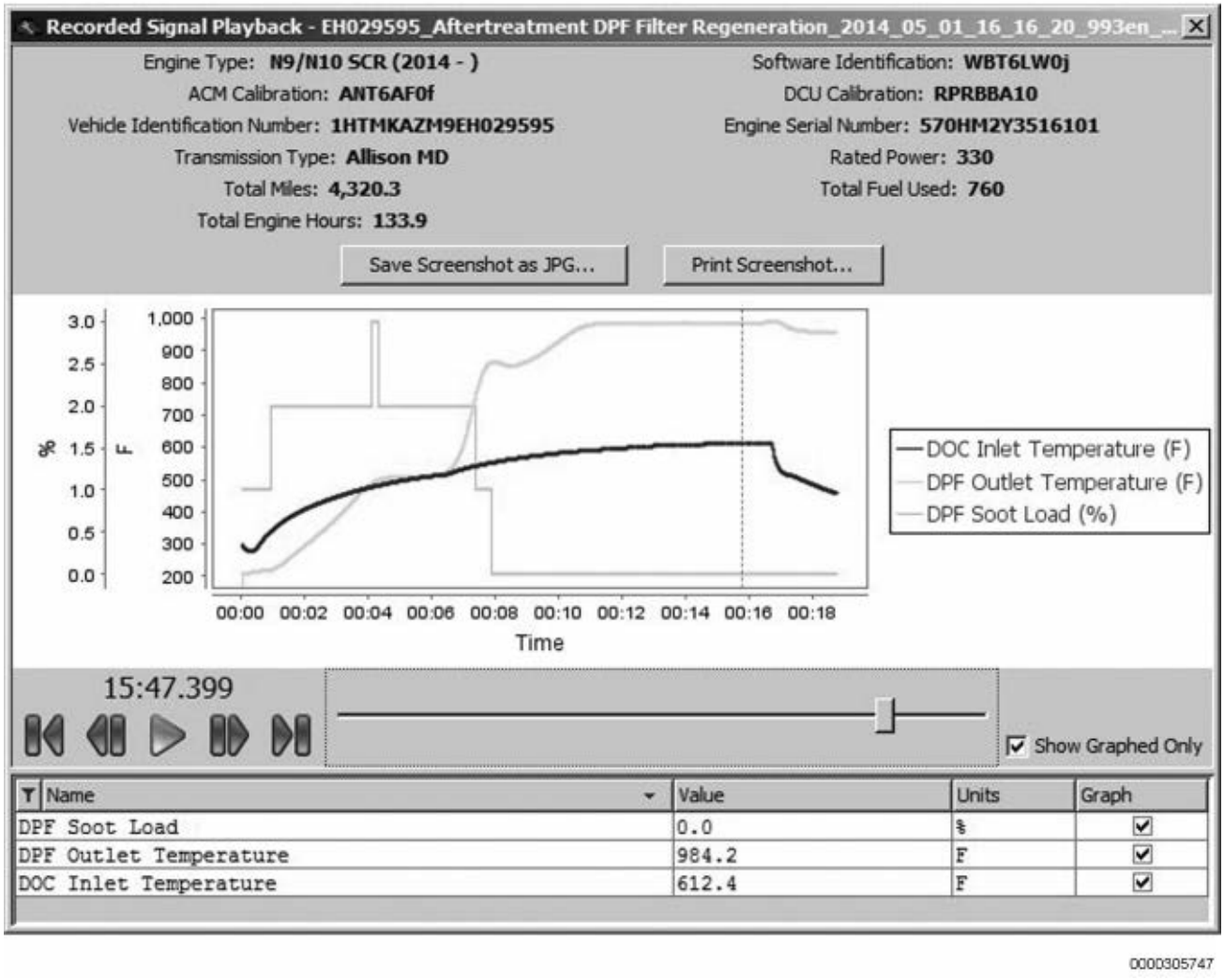


Figure 847 Snapshot Recording Playback

3. Once the recording is open (Figure 847), you can select any signal you wish to show up in the graph.

Diagnostic Trouble Code Overview

Beginning in 2010, a Diagnostic Trouble Code (DTC) consists of two parts: the Suspect Parameter Number (SPN) and Failure Mode Indicator (FMI). The SPN identifies a component or system with a fault, and the FMI identifies what that fault or condition is.

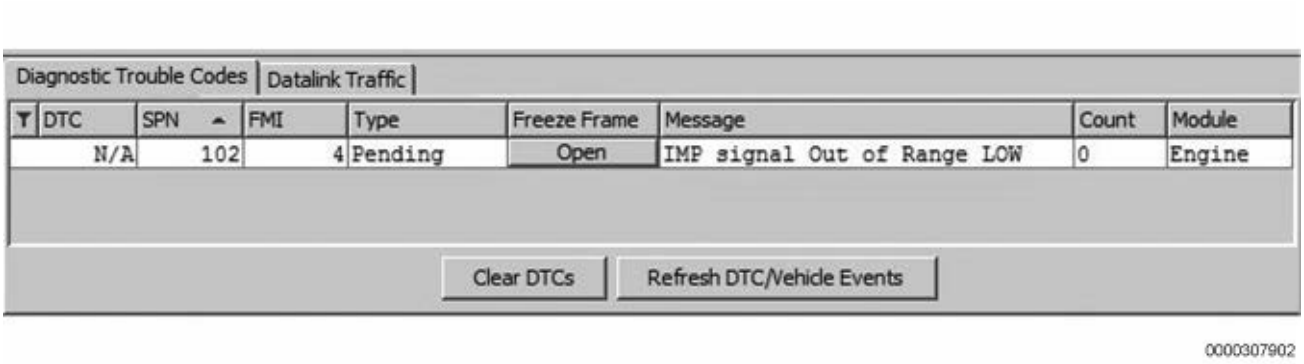


Figure 848 DTC Display

DTC Type:

Pending DTC

Pending Diagnostic Trouble Codes (DTC)s are possible faults that were detected on the first drive cycle. On Heavy Duty Onboard Diagnostic (HD-OBD) faults can be set as Pending. Pending HD-OBD faults do not turn on the Malfunction Indicator Lamp (MIL)

Active DTC

There are 3 types of Active DTCs: Non-HD-OBD faults, 1 drive cycle and 2 drive cycle HD-OBD.

- Active Non HD-OBD faults go active on the first drive cycle and do not turn on the MIL.
- Active HD-OBD 1 drive cycle faults turn on the MIL.
- Active HD-OBD 2 drive cycle faults turn on the MIL.

Healing DTC

Healing DTCs are HD-OBD faults that were active on the previous drive cycle, but were not detected on the current drive cycle. Healing faults do turn on the MIL. If the Healing fault is not detected within the next three consecutive drive cycles, then the fault becomes Previously Active and turns off the MIL.

Previously Active DTC

Previously Active DTCs are historical Active faults that were detected in a previous drive cycle. Previously Active DTCs do not turn on the MIL.

DTC Count

DTC Count logs the amount of times the fault was detected.

Freeze Frame

Freeze Frame data is a snapshot of the engines operating condition at the time the fault was detected.

Check for DTCs

ServiceMaxx™ software displays Diagnostic Trouble Codes (DTC)s at the bottom of the screen.

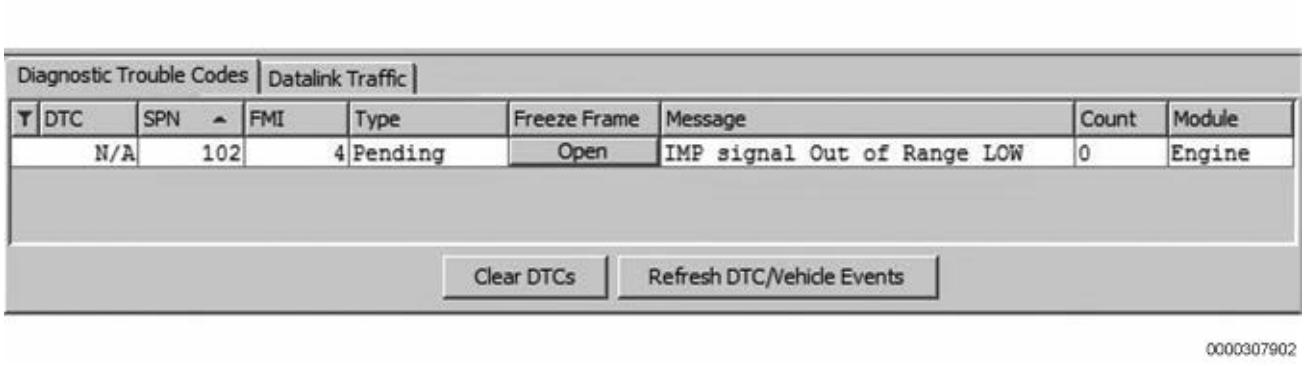


Figure 849 DTC display

Procedure:

ServiceMaxx™ software will update DTC status every 10 seconds and will check for DTCs as soon as the Refresh DTC/Vehicle Events button (Figure 849) is pressed.

Session Files

Overview

ServiceMaxx™ software has a variety of Sessions; Signal Monitoring, Engine Programming and Service Bay Testing.

Service Bay Test and Procedures will automatically load pre-made default sessions. Users are not limited to using pre-made default sessions. Sessions (Figure 850) can be built or modified, saved and loaded (Figure 851) at any time. The operator can use their own saved session to run a Service Bay test as long as the check mark is removed from the Load Test Specific Session (Figure 852) prior to running the test.

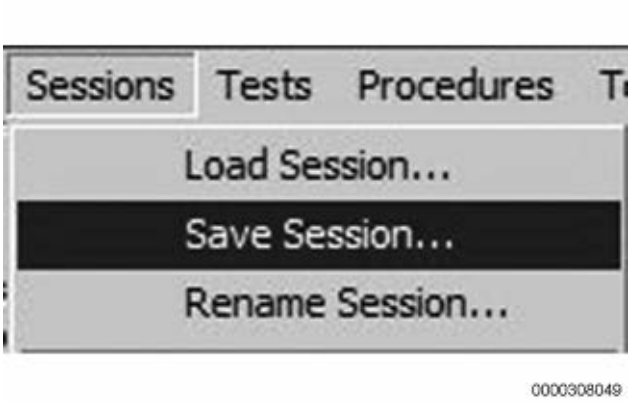


Figure 850 Menu – Save Session

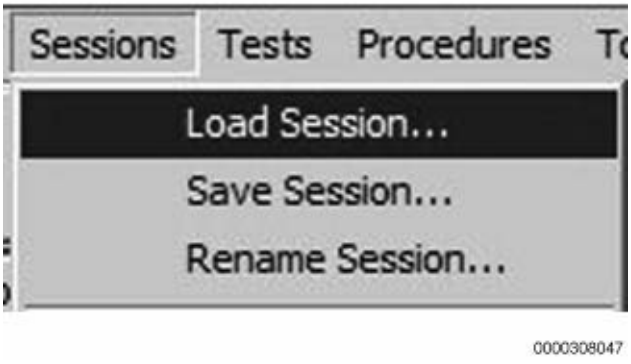


Figure 851 Menu – Load Session

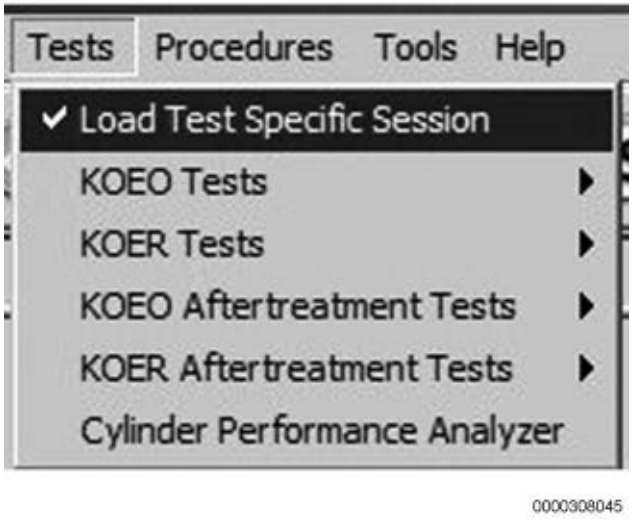


Figure 852 Menu – Load Test Specific Session

Hot Run Sensor Comparison Test

Purpose

Check for failed aftertreatment system temperature sensor.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B compliant supporting J1939 and J1708)

This test is not dependent on engine temperature.

1. Turn ignition switch to ON position.
2. Connect Electronic Service Tool (EST) with ServiceMaxx™ software to vehicle’s diagnostic connector.

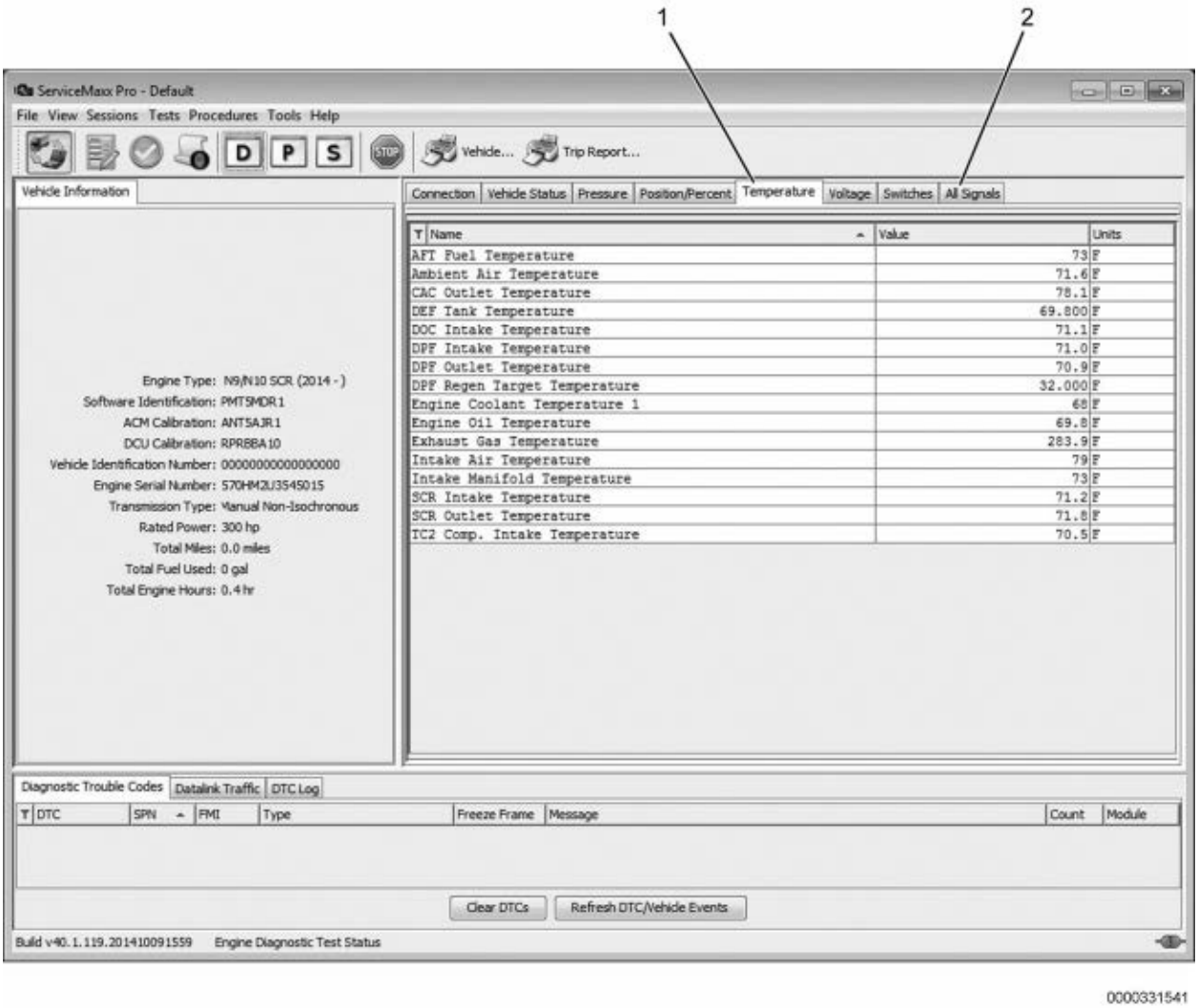


Figure 853 Default Session

1. Temperature tab
2. All Signals tab

3. Go to Default Session: Sessions > Default > Temperature tab.

WARNING: To prevent personal injury or death, shift transmission to park or neutral, set parking brake, and block wheels before doing diagnostic or service procedures.

4. Start and run engine at 1400 to 1500 rpm for 10 minutes.
5. Monitor the following signals in the All Signals tab:

   Compare the following three signals:

   - Diesel Oxidation Catalyst (DOC) Inlet Temperature
   - Diesel Particulate Filter (DPF) Inlet Temperature
   - DPF Outlet Temperature

After 10 minutes, if any of these three aftertreatment temperature sensors are not within 77°F (25°C) of each other, diagnose appropriate sensor and / or circuit.

Compare the following two signals:

- SCR Inlet Temp
- SCR Outlet Temp

After 10 minutes, if either of the two SCR temperature sensors are not within 77°F (25°C) of each other, diagnose appropriate sensor and / or circuit.

Obtain Vehicle Health Report

Overview

Connect Electronic Service Tool (EST) to vehicle and generate a Health Report of current vehicle information:

- Vehicle Identification Number (VIN) validation
- Vehicle mileage
- Engine hours
- Diagnostic Trouble Codes (DTC)
- Engine Control Module (ECM) calibration
- Fuel economy data

Tools Required

- PocketMaxx™, EST with International Graphical User Interface, or Navistar® EZ-Tech Launcher

Equipment Condition

None

Test Setup

None

Test Procedure

1. Key-On Engine-Off (KOEO).
2. Connect interface cable between PocketMaxx™, EST, or EZ-tech Launcher and to vehicle Diagnostic Connector (page 2124).
3. Use PocketMaxx™, EST, or EZ-tech Launcher to retrieve a vehicle Health Report.
4. Connect to internet and upload Health Report to Navistar® Service Portal.
5. Verify Health Report is visible on Navistar® Service Portal. Select Write Up > Vehicle Information.

Expected Outcome

Current vehicle Health Report is viewable on Navistar® Service Portal.

Follow-On Procedure

None

Programmable Features

Overview

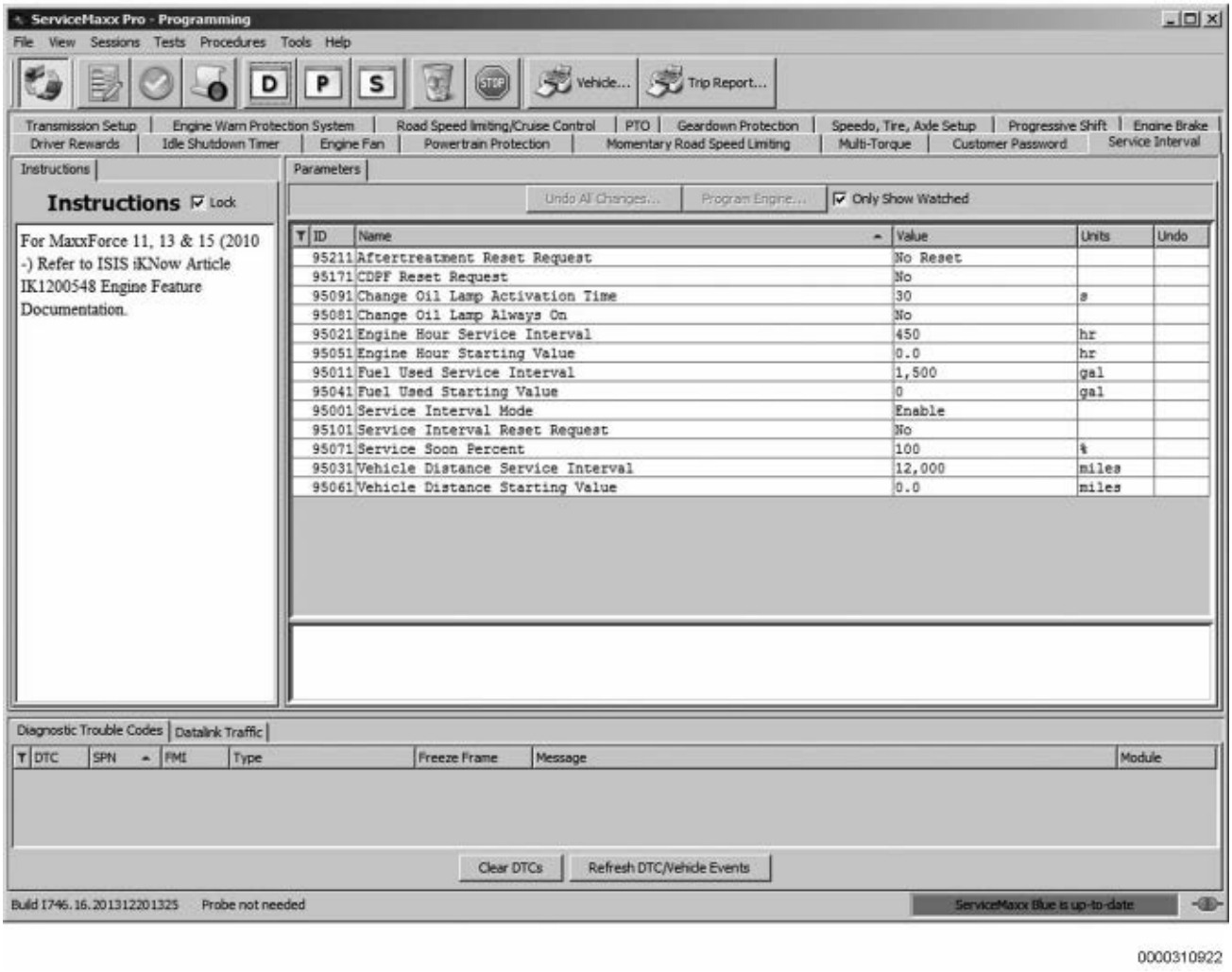
Many features can be programmed into the Engine Control Module (ECM) to fit many different applications. To make programming changes using ServiceMaxx™ software, load the Programming session.

Tool Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None



0000310922

Figure 854 Programmable Feature

Test Setup

1. Key-On Engine-Off (KOEO)
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure

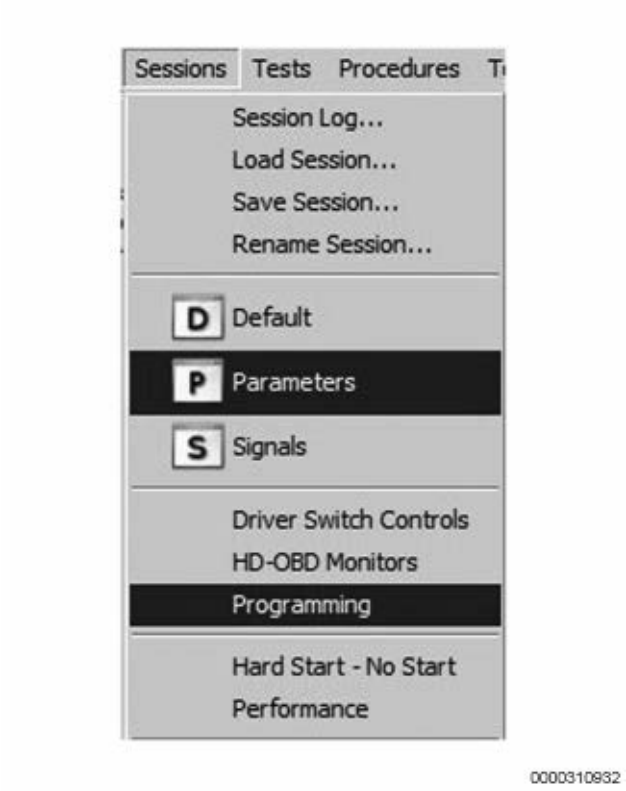


Figure 855 Select Parameters or Programming

1. Select Programming (Figure 855) from the Session drop-down menu.

- Select Parameters to view all Parameters
- Select Programming to view Parameters sorted into categories.

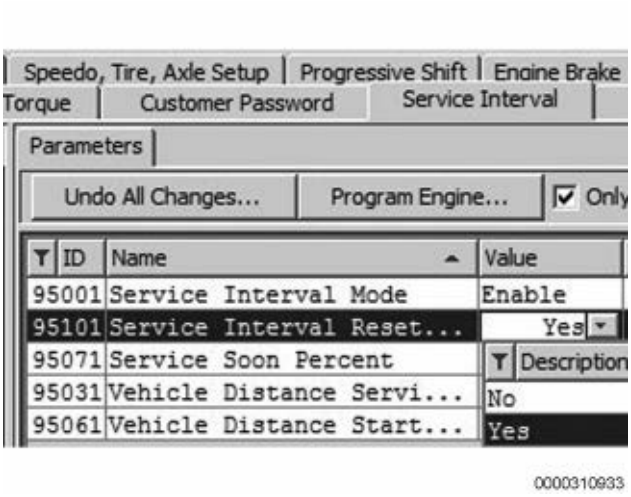


Figure 856 Change Parameter Value

2. Click on the desired parameter value (Figure 856) to be changed.

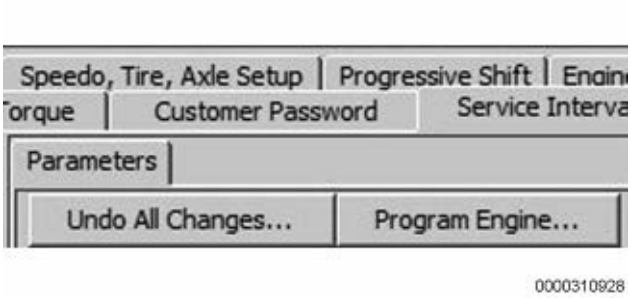


Figure 857 Program Engine

3. Press the Program Engine Button (Figure 857).



Figure 858 Program Engine

4. Turn Key OFF for 15 seconds, so new value change be saved into the module (Figure 858).
5. Turn Key ON.
6. Clear Diagnostic Trouble Code (DTC)s, if any.

Expected Outcome

None

Follow-On Procedure

None

Record Snapshot of KOEO Data

Overview

Record Key-On Engine-Off (KOEO) data to be referenced now, and in the future.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

1. Do not crank or run engine for 3 minutes or more. This will allow Injection Control Pressure (ICP) to bleed off.

Test Setup

1. Key-ON.
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.

Test Procedure

1. Select Sessions > Performance.
2. Cycle key OFF, then cycle key ON.

NOTE: Fuel pump will run for 10 seconds after the ignition key is cycled.

3. Select Tools > Start Recording Snapshot.
4. Wiggle harness connections on the Under Valve Cover (UVC) harness for ICP connector, ICP harness, and 36-pin Engine Control Module (ECM) connector.
5. Select Tools > Stop Recording Snapshot.

Expected Outcome

KOEO values will be within specification.

Follow-On Procedure

None

Injector Coil End of Motion (CEOM) Reset Procedure

Overview

Injector Coil End Of Motion (CEOM) corrects aging effect of fuel injector on fuel quantity. Over time injectors inject less fuel due to injectors wearing. CEOM measures this wear and adds fuel back in to make it work like new. When a new injector is installed in the engine, CEOM should be reset so it does not add too much fuel to engine.

NOTE: Only reset CEOM of injector being replaced.

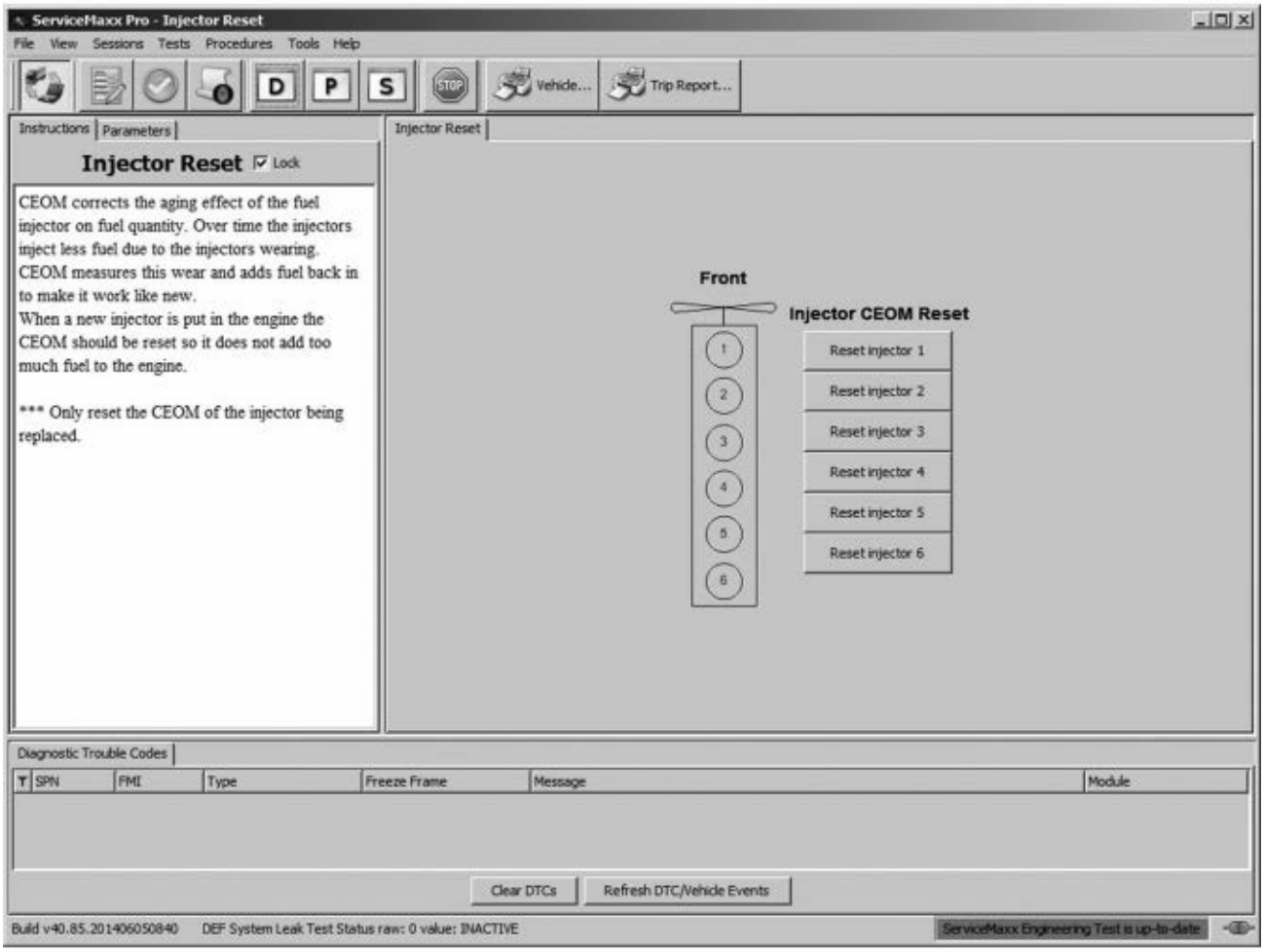
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

Key-On Engine-Off (KOEO)

Test Setup



0000306607

Figure 859 Injector Reset

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start ServiceMaxx™ software.

Test Procedure

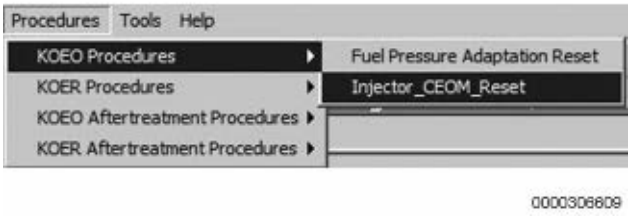


Figure 860 Menu – Select Procedure

1. Select Injector CEOM Reset (Figure 860) from the KOEO Procedures drop-down menu.

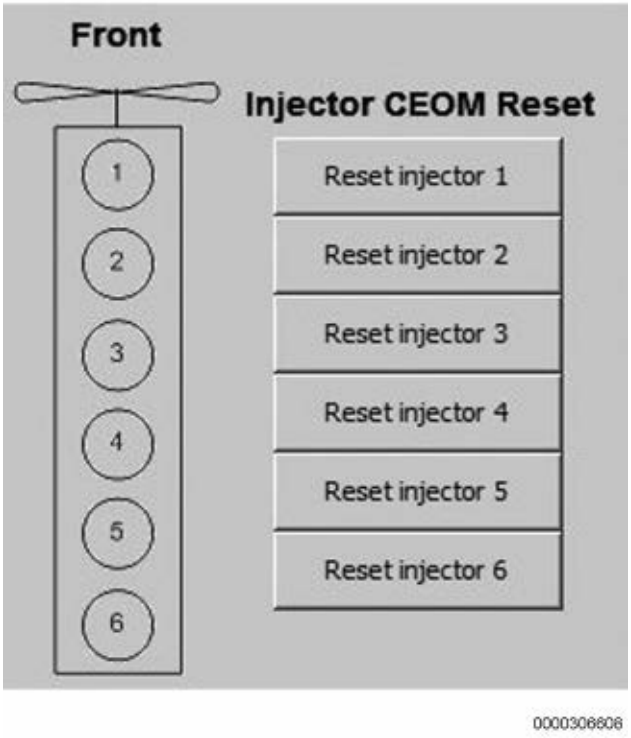


Figure 861 Injector reset panel

2. Only reset the injector (Figure 861) that was replaced to prevent any injection imbalance.

Fuel Pressure Adaptation Reset

Overview

Engine Control Module (ECM) maintains reliability of Fuel Rail Pressure (FRP) system as parts age by storing Fuel Pressure Adaptation (FPA) values.

When any fuel system part is replaced: [Engine Injection Pressure Regulator (IPR) valve, Injection Control Pressure (ICP) sensor, high-pressure pump, high-pressure rail, or ECM], this parameter must be reset.

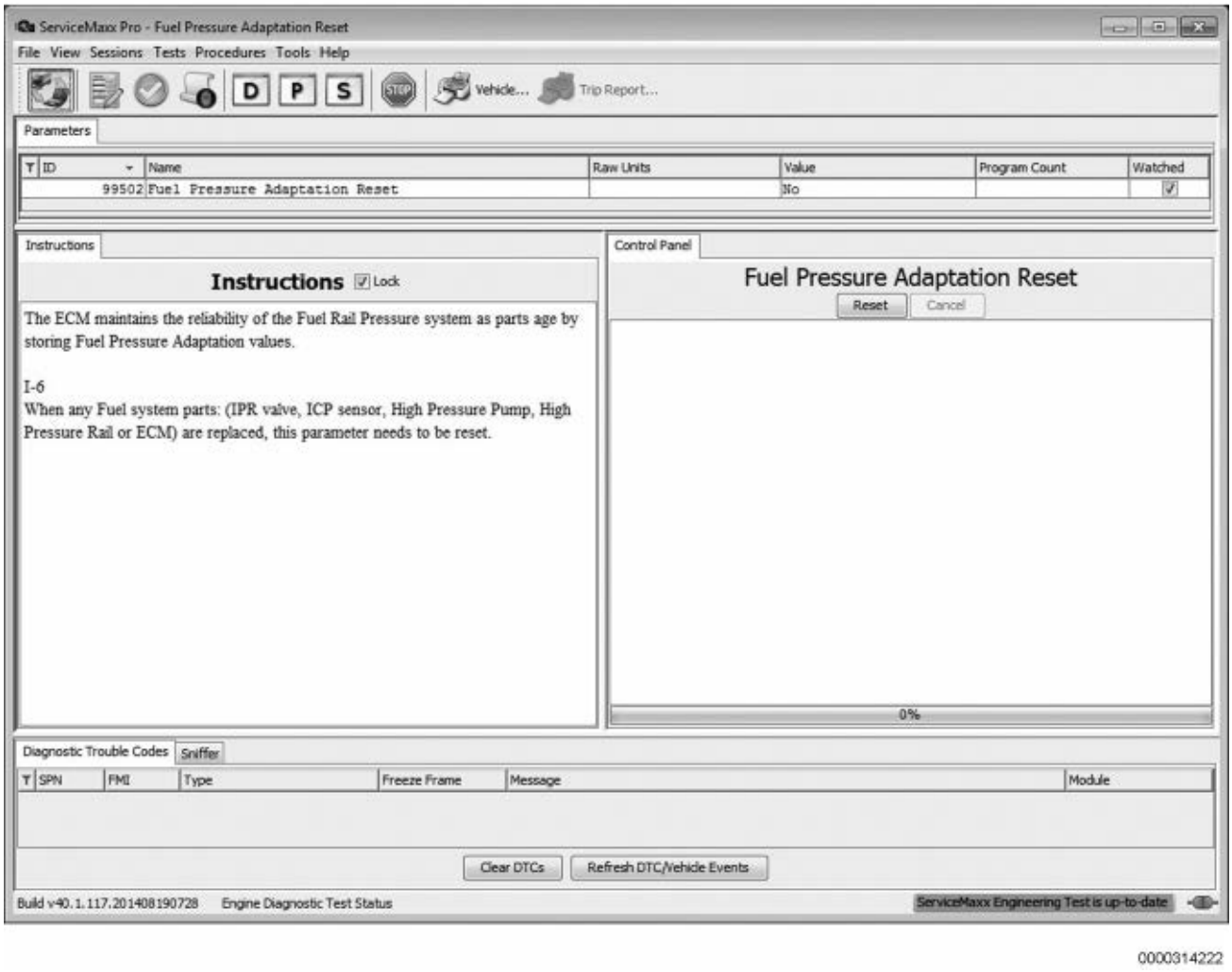
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (J1939 - compliant)

Equipment Condition

One of the following components was replaced:

- Engine Injection Control Pressure Regulator (IPR)
- Injection Control Pressure (ICP) sensor
- High-pressure pump
- High-pressure rail
- Engine Control Module (ECM)



0000314222

Figure 862 Fuel Pressure Adaptation Reset Screen

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start ServiceMaxx™ software.

Test Procedure

1. Replace failed part.

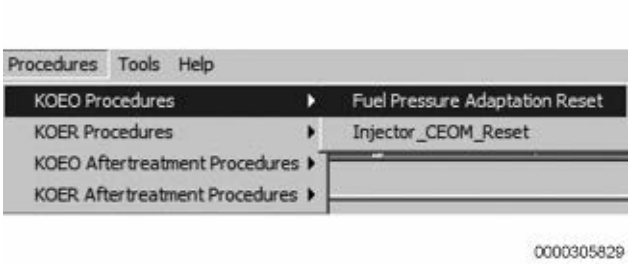


Figure 863 Fuel Pressure Adaptation Rest Drop-Down Menu

2. Select Fuel Pressure Adaptation Reset from KOEO Procedure (Figure 863) drop down menu.



Figure 864 Reset Button

3. Press Fuel Pressure Adaptation Reset button (Figure 864).

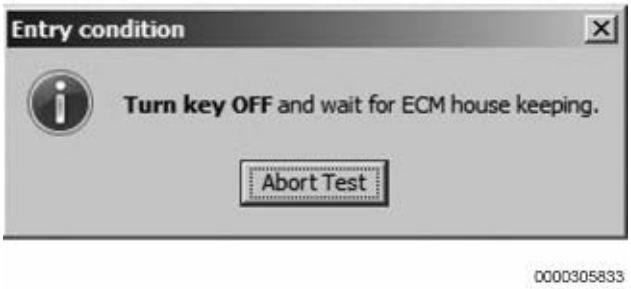


Figure 865 Example of on-screen Instructions

4. Follow on-screen instructions (Figure 865).

Follow-On Procedure

None

KOEO DOC / DPF Replacement / Reset Procedure

Overview

The Aftertreatment (AFT) maintenance provides the ability for a technician to install/reset maintenance components. An example would be a new or clean Diesel Oxidation Catalyst (DOC) or Diesel Particulate Filter (DPF). Once a DOC is considered by the Engine Control Module (ECM) to be “Face Plugged”, AFT dosing is disabled. After the DOC is replaced, the technician would need to reset the value to clean in order to enable dosing and re-initiate active regeneration. In order to prevent the misuse of this feature, the reset shall only be available when most severe fault conditions exist on the particular AFT component that is being reset.

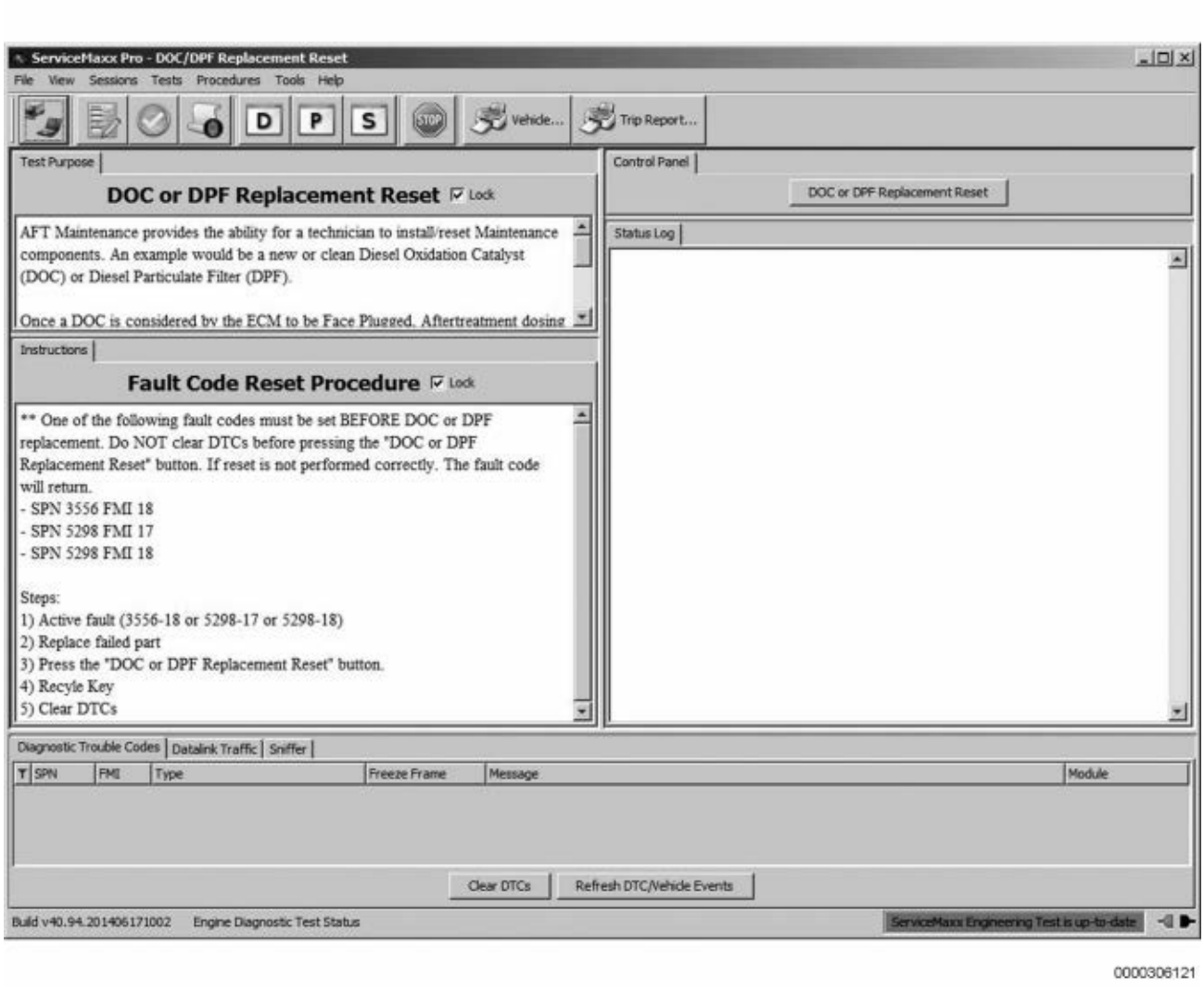


Figure 866 DOC / DPF Replacement Reset

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

One of the following active faults:

- SPN 3556 FMI 18
- SPN 5298 FMI 17
- SPN 5298 FMI 18

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect interface cable between Electronic Service Tool (EST) and 9-pin Vehicle Data Connector (VDC) (see Connecting EST with ServiceMaxx™ software to engine (page 2124)).
3. Start ServiceMaxx™ software.

Test Procedure

1. Verify that one of the active faults is present:
   - SPN 3556 FMI 18
   - SPN 5298 FMI 17
   - SPN 5298 FMI 18
2. Replace the failed part.



Figure 867 Menu – Select Procedure

3. Select DOC / DPF Replacement Reset from the KOEO Aftertreatment Procedures (Figure 867)drop-down menu.

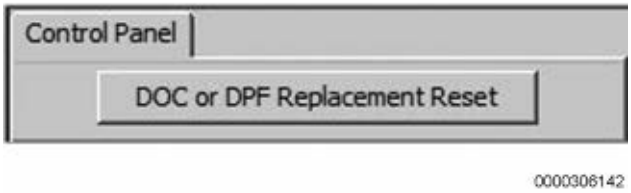


Figure 868 DOC or DPF Replacement Reset Button

4. Press the DOC or DPF Replacement Reset button (Figure 868).
5. Clear Diagnostic Trouble Codes (DTCs).

Intermittent or Inactive Fault Diagnostic Procedure

Overview

Use this test to diagnose inactive and/or intermittent faults. Inactive and/or intermittent faults are currently healing, previously active, or inactive.

NOTE: For component faults that are pending or active, follow specific step based diagnostics for fault.

NOTE: Permanent faults are historic faults and are used for reporting purposes only. They should never be treated as a current issue or used for diagnostics.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939–compliant interface cable

Equipment Condition

None

Test Setup

1. Key-On, Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure

1. Verify health report was saved. Clear fault codes.
2. Perform Continuous Monitor Test (page 2147)and view voltage signal for suspect sensor.
    - The continuous monitor test will have you watch voltage signals for voltage spikes while wiggling affected harness and connections.
    - A voltage spike while performing continuous monitor wiggle test indicates a damaged harness and/or connector pin.

NOTE: During continuous monitor wiggle test, if a fault code sets (high or low), voltage will latch high or low. To continue performing continuous monitor wiggle test, faults will need to be cleared.

3. If a voltage spike or fault occurs during continuous monitor wiggle test start from the point the voltage spike occurred and inspect harness for rubbing, and inspect nearby connectors for pin damage, corrosion, fretting, etc.

Expected Outcome

The source of the intermittent / inactive fault will be isolated.

Follow-On Procedure

None

Connecting EST with ServiceMaxx™ Software to Engine

Interface Device Selection

To connect Electronic Service Tool (EST) with ServiceMaxx™ software to an engine, an interface cable (RP1210B compliant supporting J1939 and J1708) must be connected between EST and vehicle diagnostic connector. The vehicle diagnostic connector is located inside vehicle cab, above clutch pedal.

1. Using Interface cable, connect EST (Electronic Service Tool) to vehicle's diagnostic connector.
2. Start ServiceMaxx™ software.

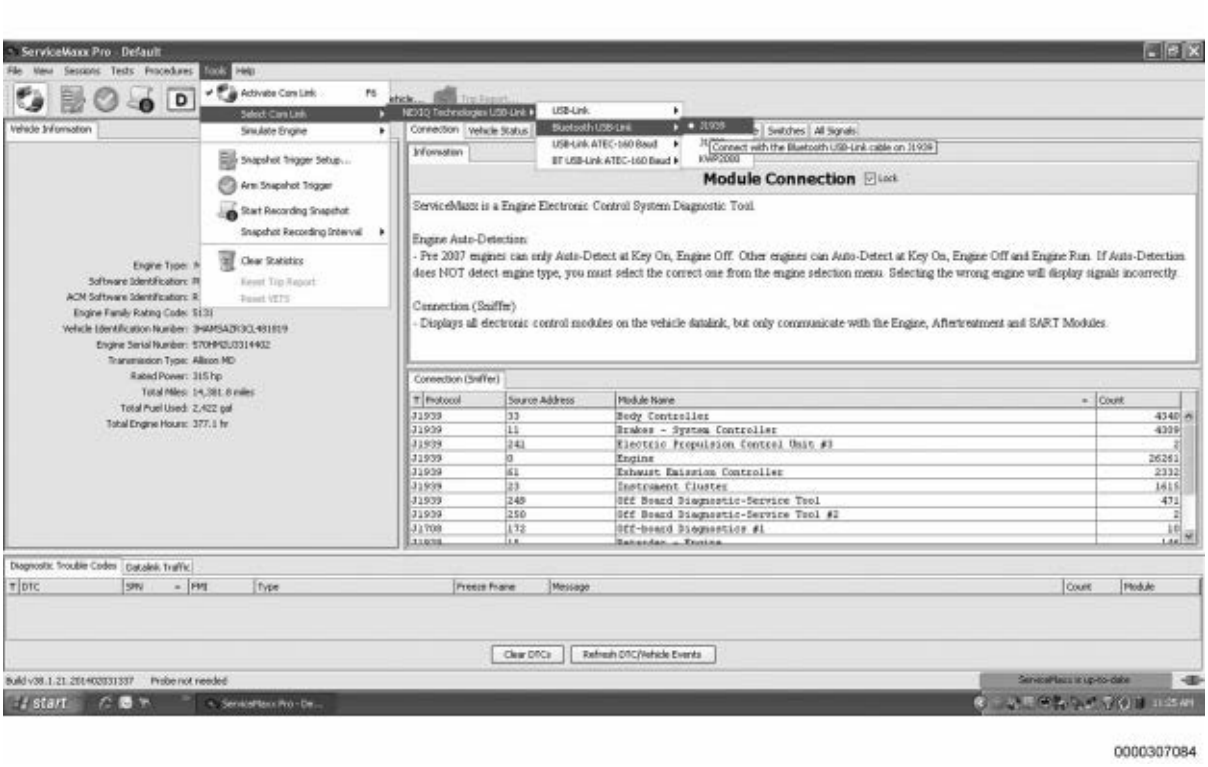


Figure 869 Com Link Selection Drop Down Menu

3. Select Com Link (Figure 869).

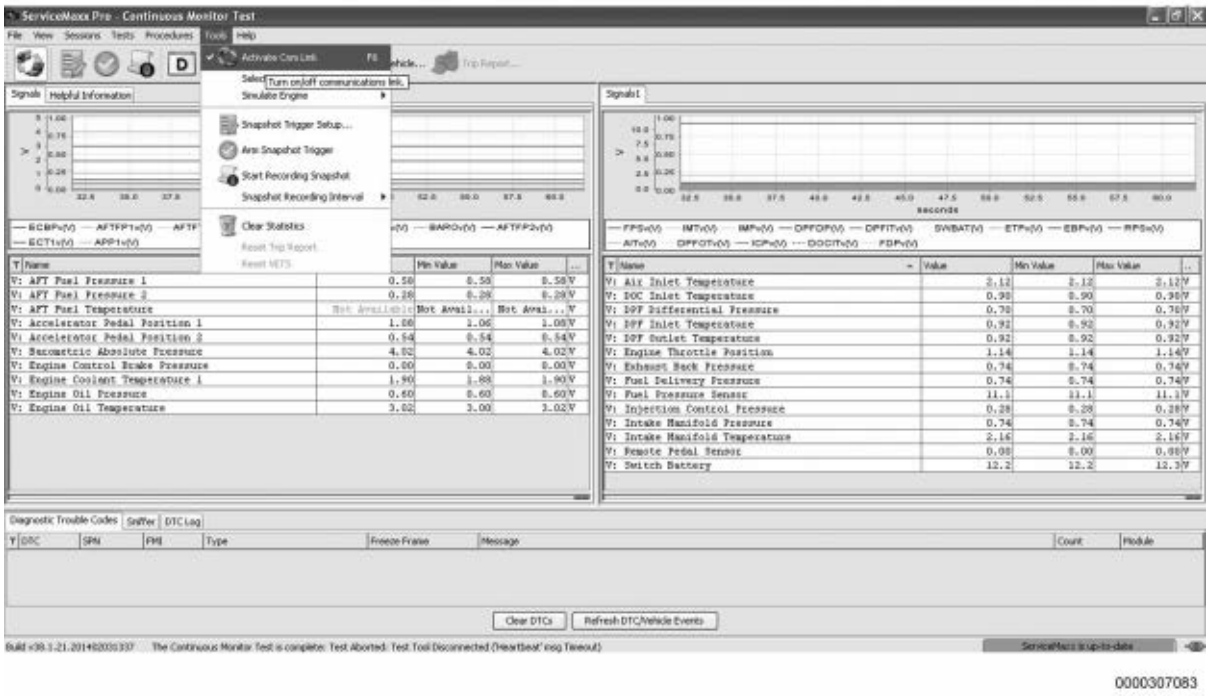


Figure 870 Com Link Activation Drop Down Menu

4. Activate Com Link (Figure 870) for interface cable connection.

If ServiceMaxx™ software fails to autoconnect, use the following procedure:

5. From Tools drop-down menu, go to Select Com Link (Figure 869).

6. Select cable / interface device.
    a. NEXIQ Technologies USB-Link
        — USB-Link
            • J1939
            • J1708
            • KWP2000
        — Bluetooth USB-Link
            • J1939
            • J1708
            • KWP2000
        — USB-Link ATEC 160–Baud
            • J1939
            • J1708
            • KWP2000
        — BT USB-Link ATEC 160–Baud
            • J1939
            • J1708
            • KWP2000

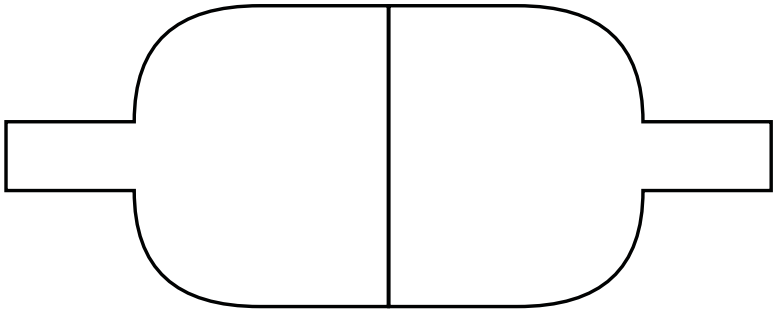
NOTE: If software is still unable to connect, see troubleshooting documentation provided for specific interface cable being used (provided from cable manufacturer).

If cable is not at fault, see J1939 Data Link Error (ECM unable to transmit) (page 1780) in Fault Code Diagnostics section of this manual.

Connecting ServiceMaxx™ Software

1. Turn ignition switch to ON. Do not start engine.
2. Using interface cable, connect EST to vehicle's diagnostic connector.
3. Start ServiceMaxx™ software. After starting ServiceMaxx™ software and selecting appropriate interface device, (Interface Device Selection) (page 2124), a detection process will begin and should connect automatically.

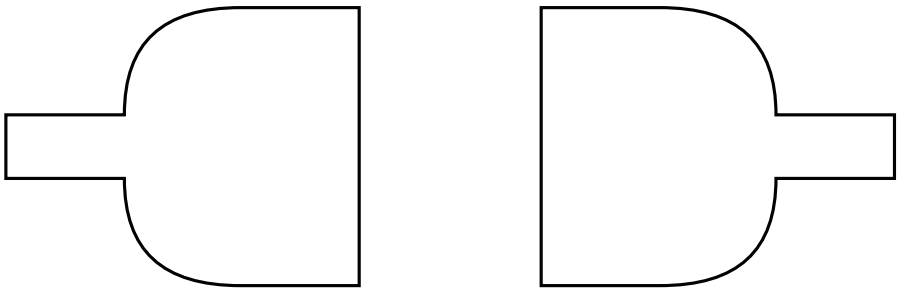
   NOTE: If ServiceMaxx™ software cannot detect Engine Serial Number (ESN), then it may be necessary for user to select engine by clicking on Select Engine from File drop-down menu. Then select engine from pop-up box.



0000307081

Figure 871 ECM Connected Icon

NOTE: If software has connected to the ECM, active signals will populate startup screen, and ECM connected icon in bottom right corner will show connected.



0000307082

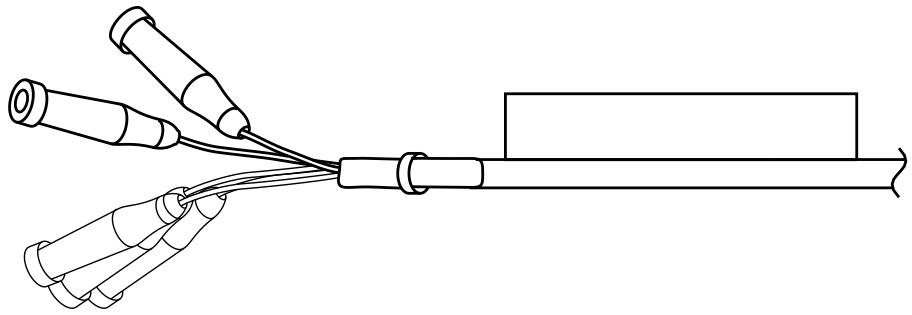
Figure 872 ECM Disconnected Icon

NOTE: When software is unable to connect to ECM, signals and vehicle information will not be displayed, and ECM disconnected icon in bottom right corner will show disconnected.

If software is unable to connect to ECM, go to Interface Device Selection (page 2124) section, above.

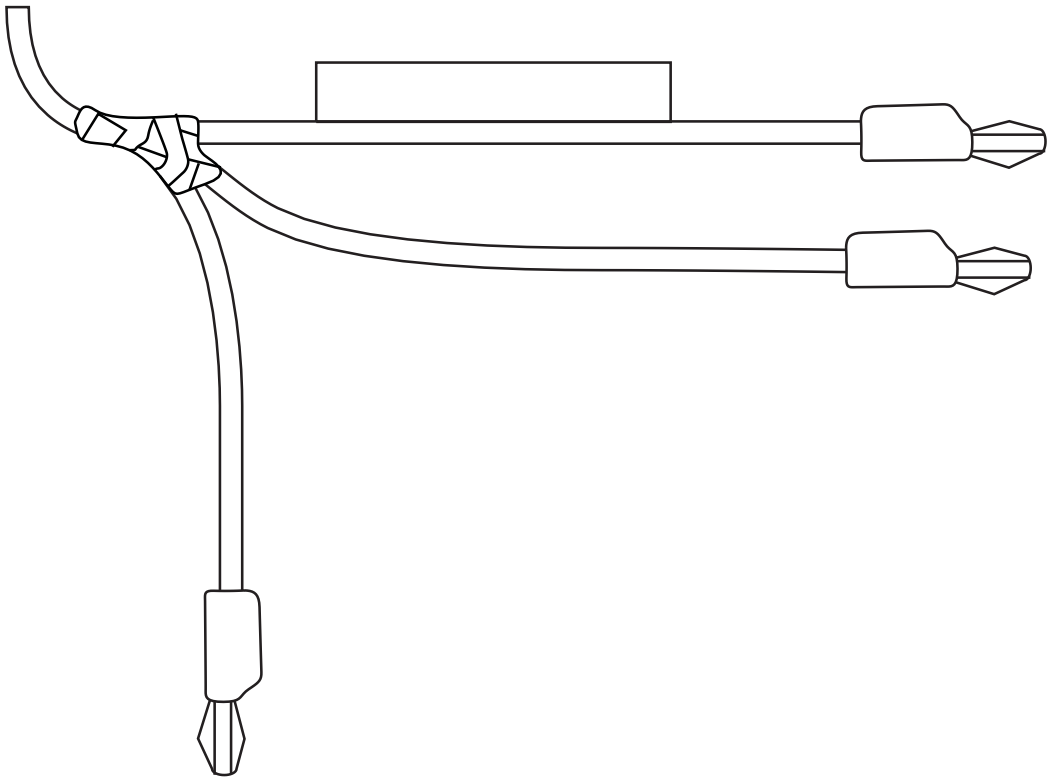
Pinpoint Diagnostic Graphic Legend

This defines the graphic depictions of tools required for Pin Point Tests in the Fault Code Diagnostics section of this manual.



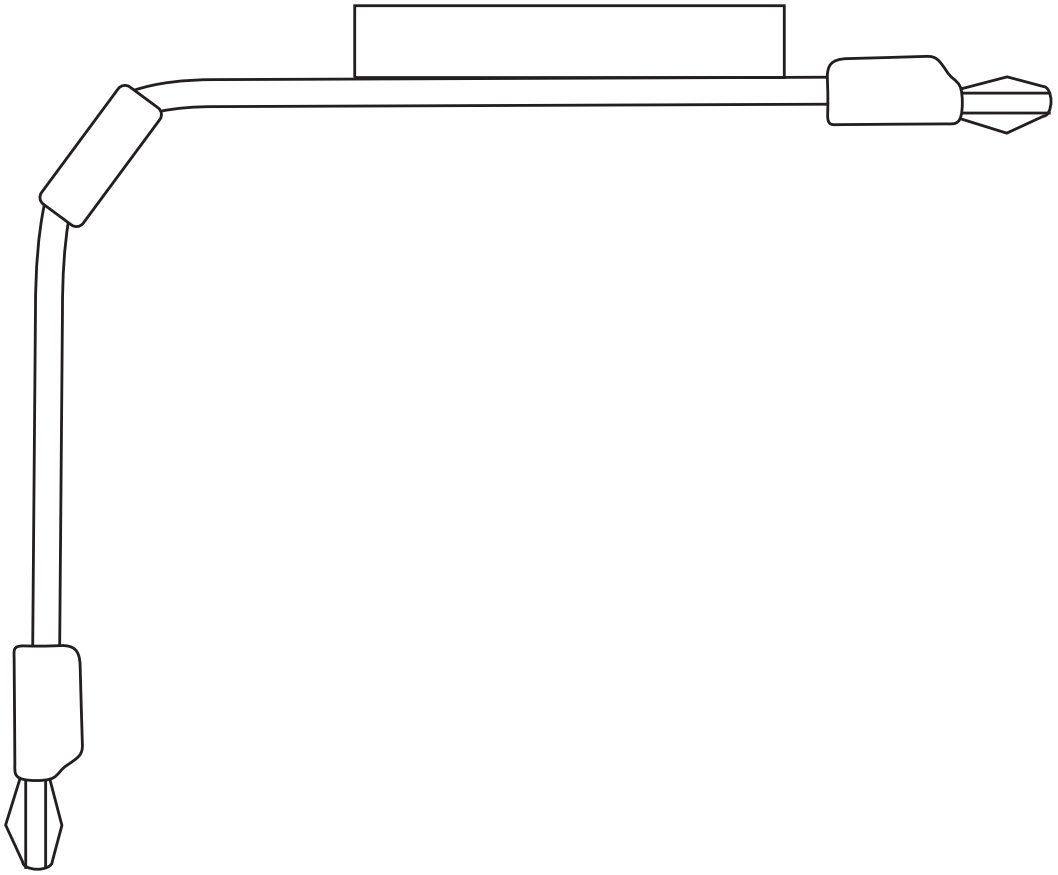
0000304602

Figure 873 Breakout Harness



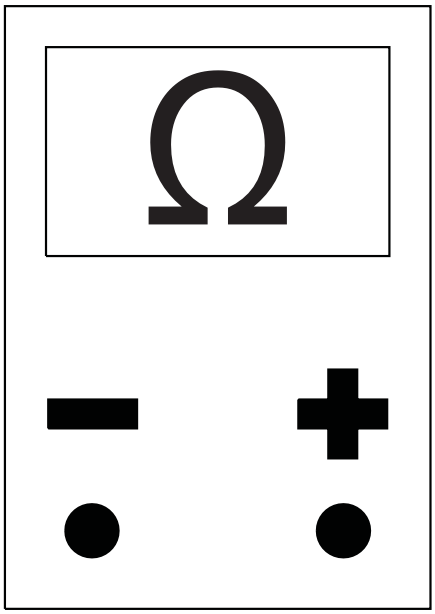
0000299043

Figure 874 ZTSE4498 – 3–Banana Plug Harness



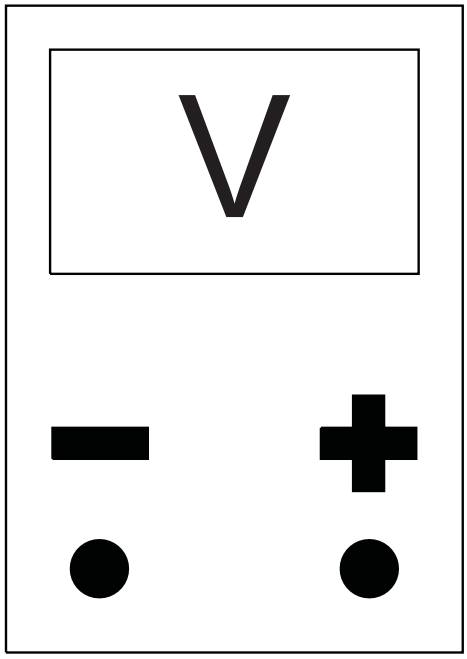
0000319141

Figure 875 ZTSE4497 — 500 Ohm Resistor



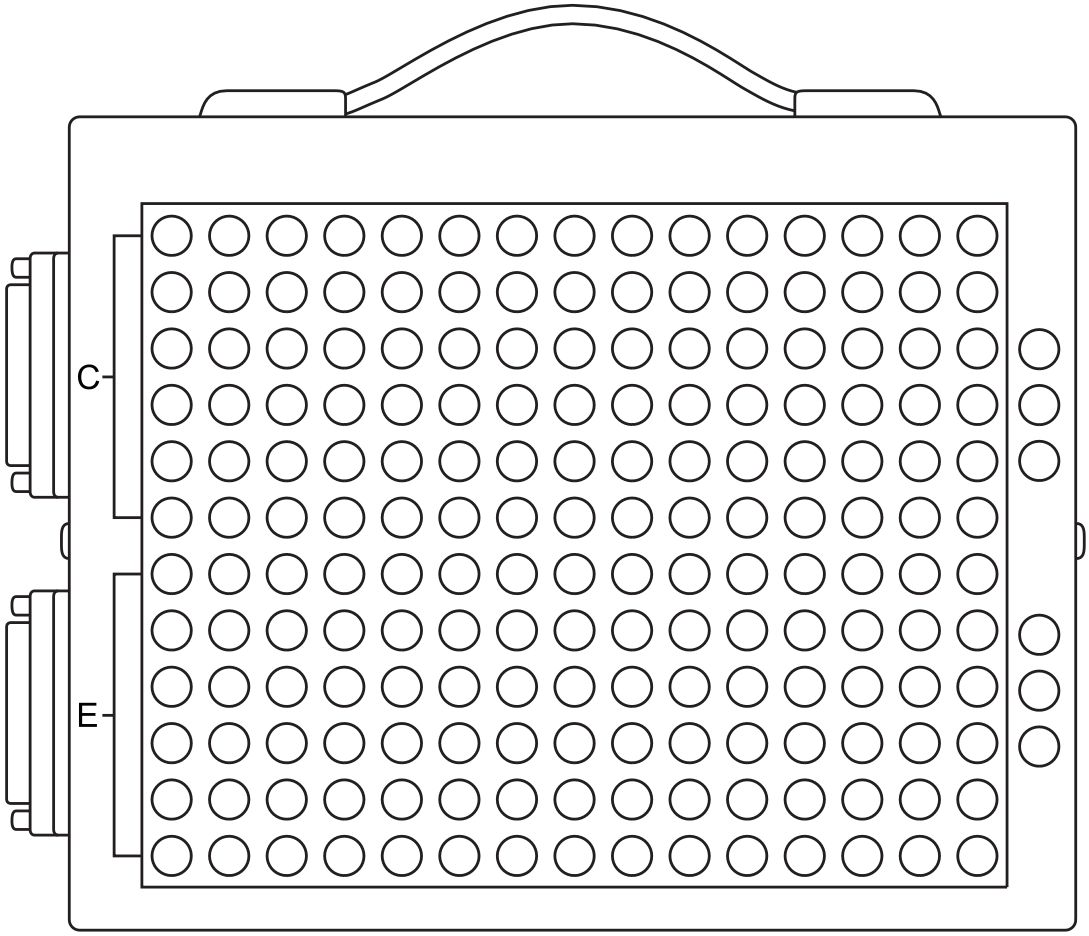
0000304621

Figure 876 Ohm Meter



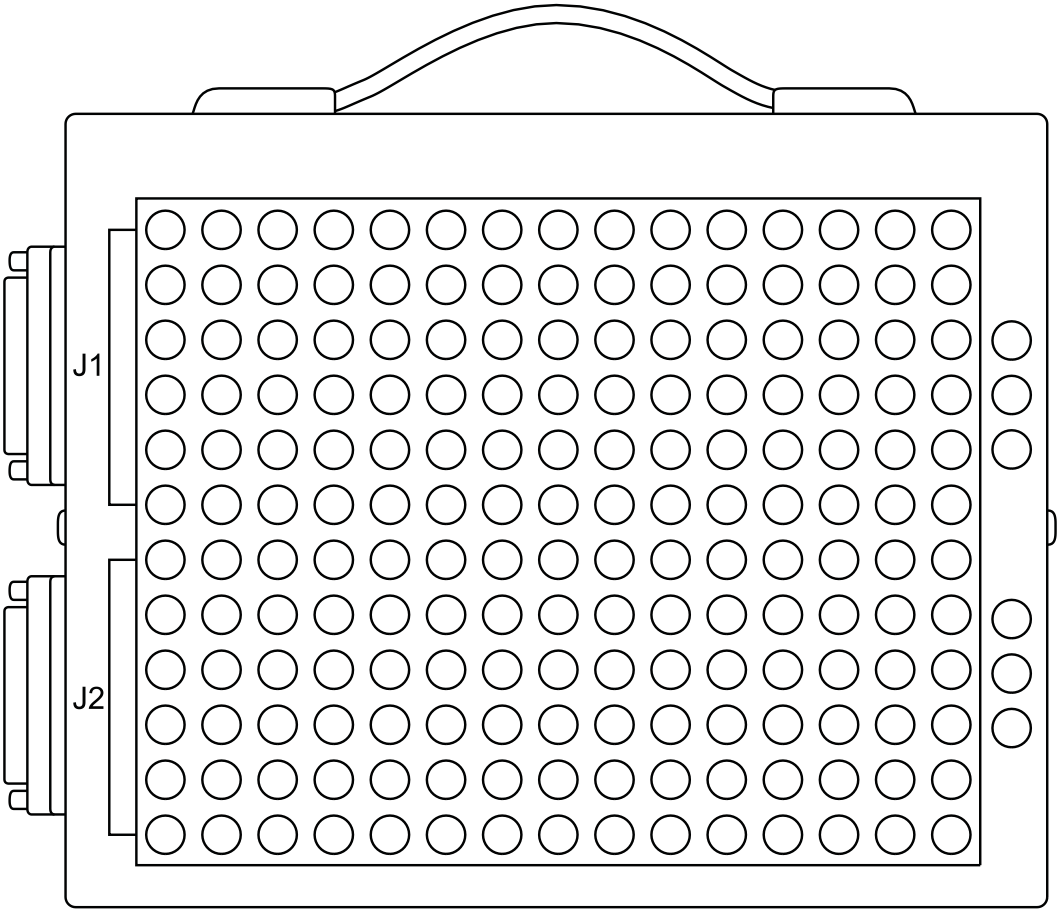
0000304622

Figure 877 Volt Meter



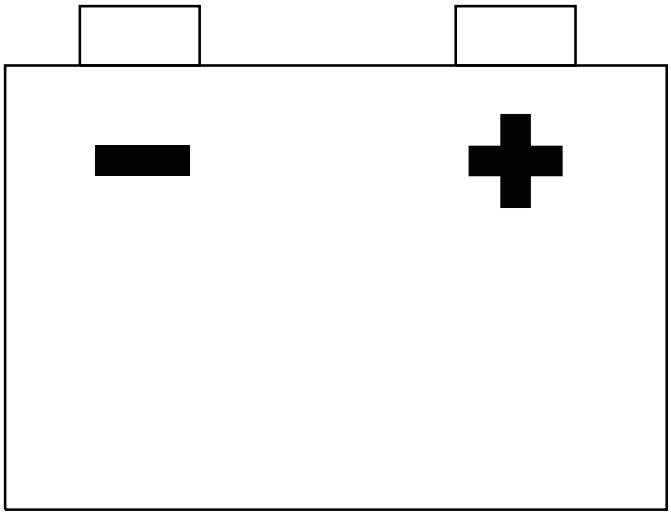
0000304646

Figure 878 ECM (Engine Control Module) 180 Pin Breakout Harness Overlay



0000304645

Figure 879 ACM (Aftertreatment Control Module) 180 Pin Breakout Harness Overlay



0000304647

Figure 880 Battery

Service Bay Tests

Engine Off Tests

KOEO Standard Test

Overview

The Key-On, Engine-Off (KOEO) Standard Test will command all Engine Control Module (ECM) actuators to their high state and then back to their normal, low state. This test allows the user to diagnose actuator movement by commanding the actuators high and low while using a multi-meter to measure circuits. This test also enables the visual monitoring of movement on some of the actuators.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

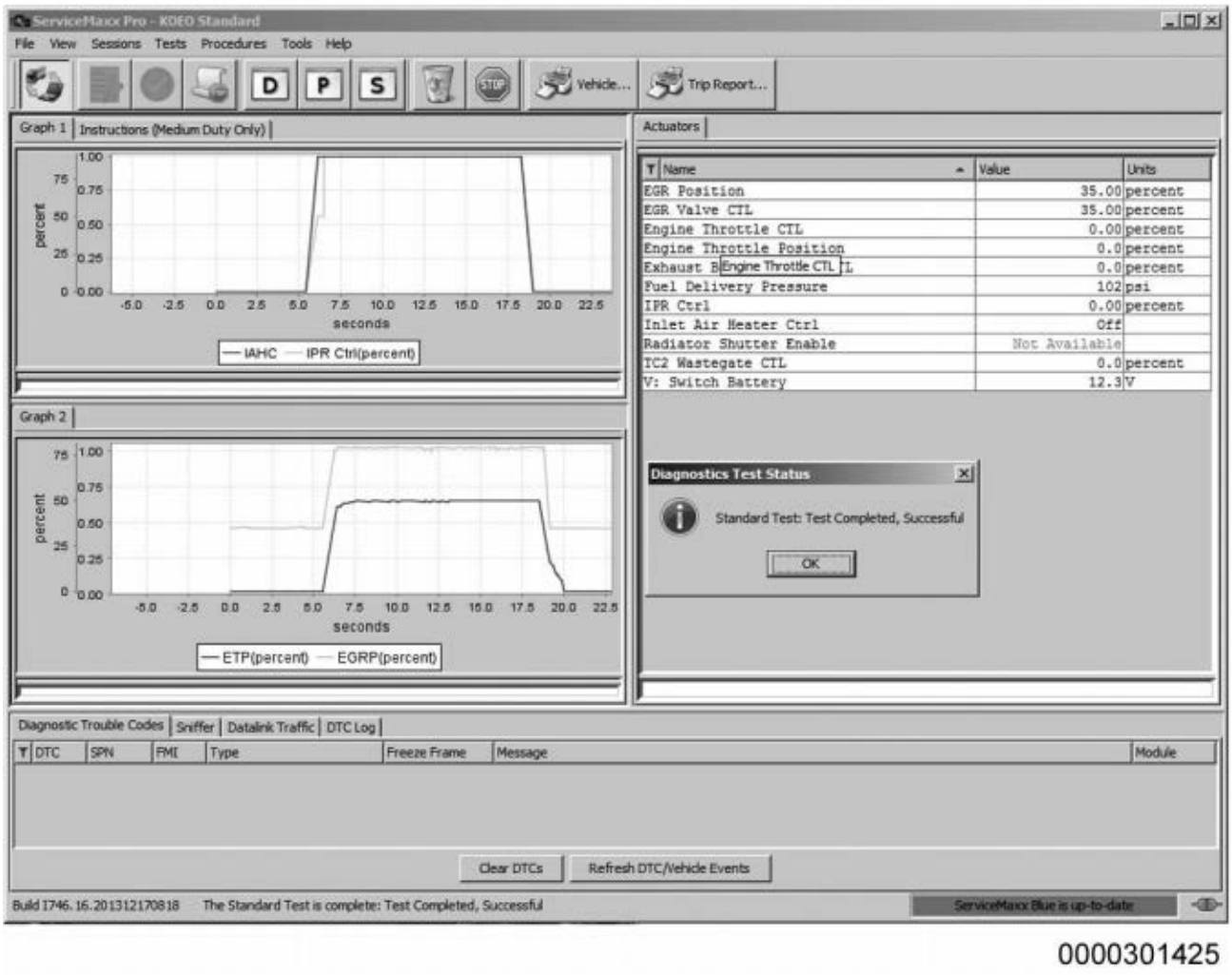
Equipment Condition

None

NOTE: All actuators default at their low state.

NOTE: Actuators cycled during this test are as follows:

- Engine Throttle Position (ETP)
- Injection Pressure Regulator (IPR)
- Intake Air Heater (IAH)
- Radiator Shutter (optional)
- Exhaust Gas Recirculation (EGR) Valve
- Fuel Delivery Pump (FDP)
- Turbocharger 2 Wastegate Position (TC2WG)



0000301425

Figure 881 KOEO Standard Test

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start and log in to ServiceMaxx™ software.

Test Procedure

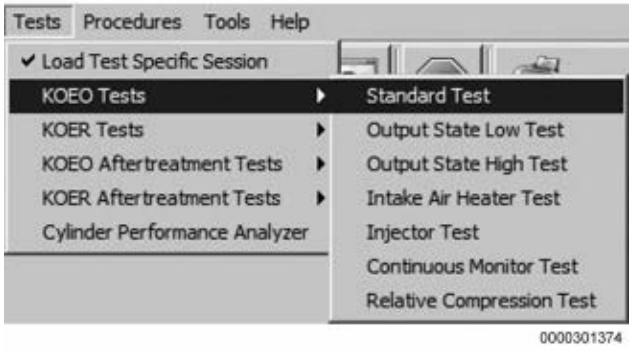
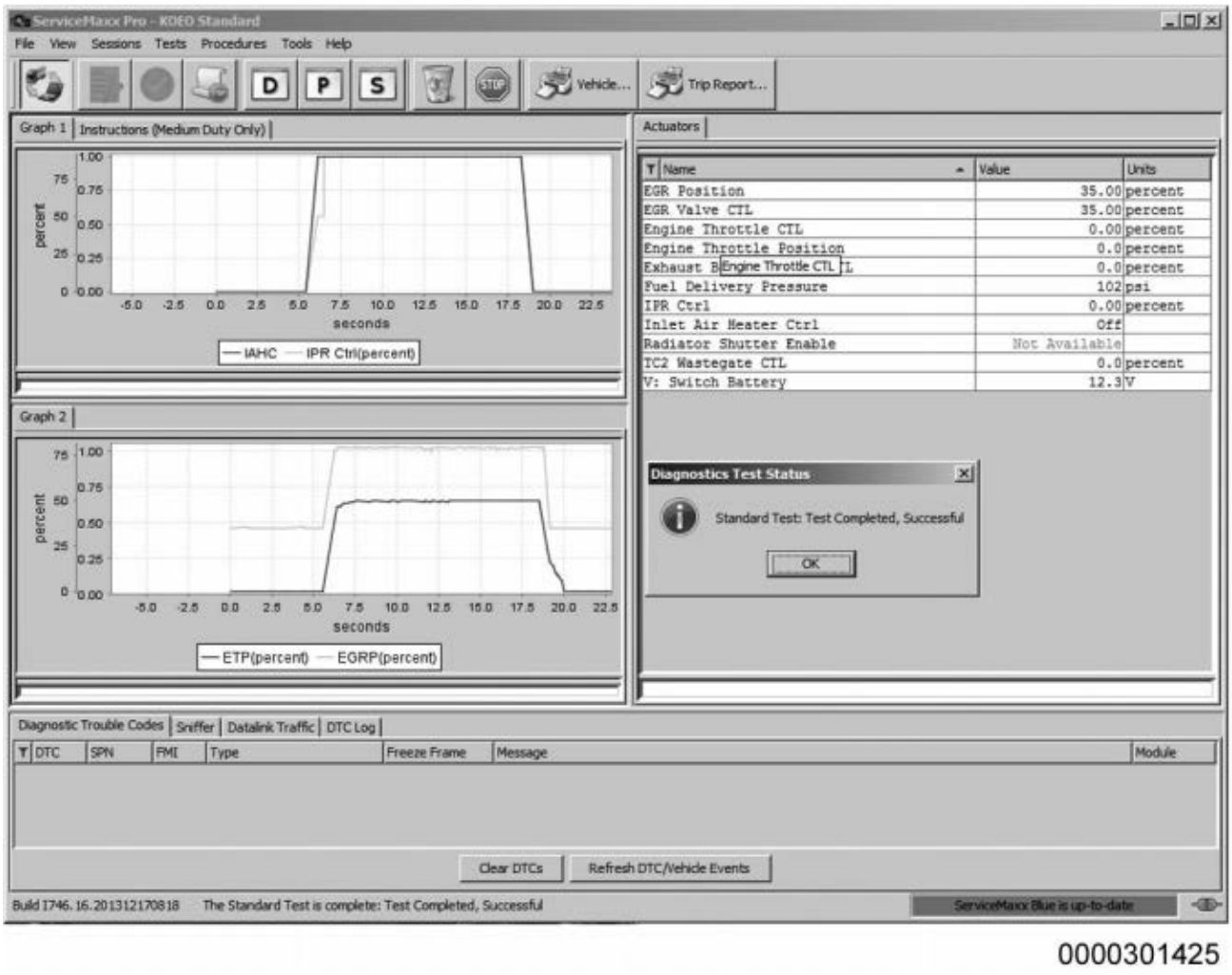


Figure 882 Menu — Select Test

1. Select Key-On Engine-Off (KOEO) Standard Test (Figure 882) from the Tests drop-down menu.

NOTE: This test does not display pass or fail results and will display test complete when finished.



0000301425

Figure 883 KOEO Standard Test Complete

Expected Outcome

Key-On Engine-Off test will complete without any problems occurring.

Follow-On Procedure

None

KOEO Low to High Idle Test

Overview

This test is used to validate engine performance throughout its full rpm range. By monitoring specific signals, this test helps identify which systems are not performing as expected. Using information gathered, it assists with further diagnostics.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure

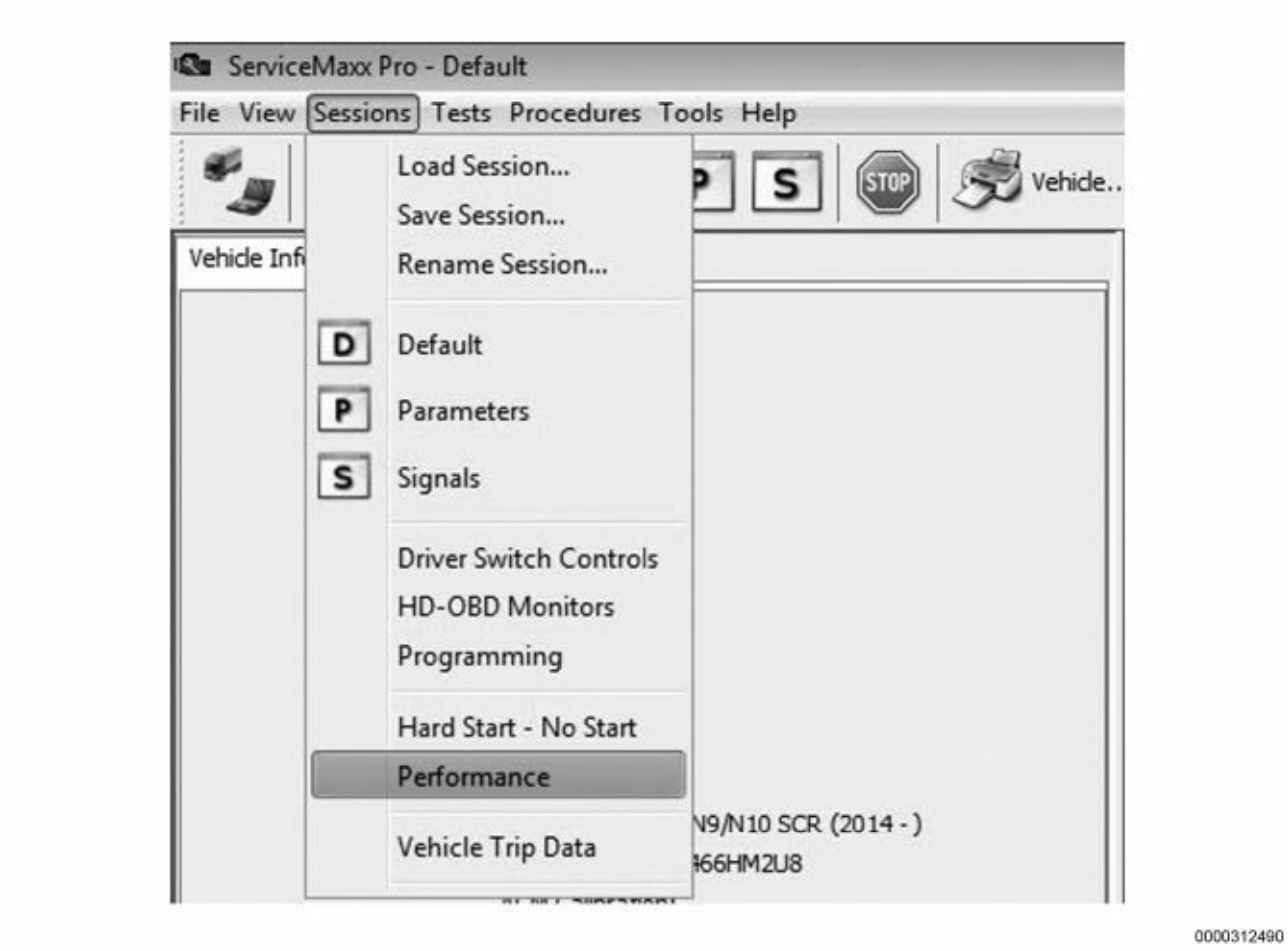


Figure 884 Menu – Sessions

1. Select Sessions > Performance (Figure 884).
2. Press accelerator pedal to floor while monitoring the Accelerator Pedal Position (APP) signal value.
3. If APP signal consistently reads from 0 to approximately 99.6% continue test. If APP system is not consistent, repair APP system as needed before continuing test.

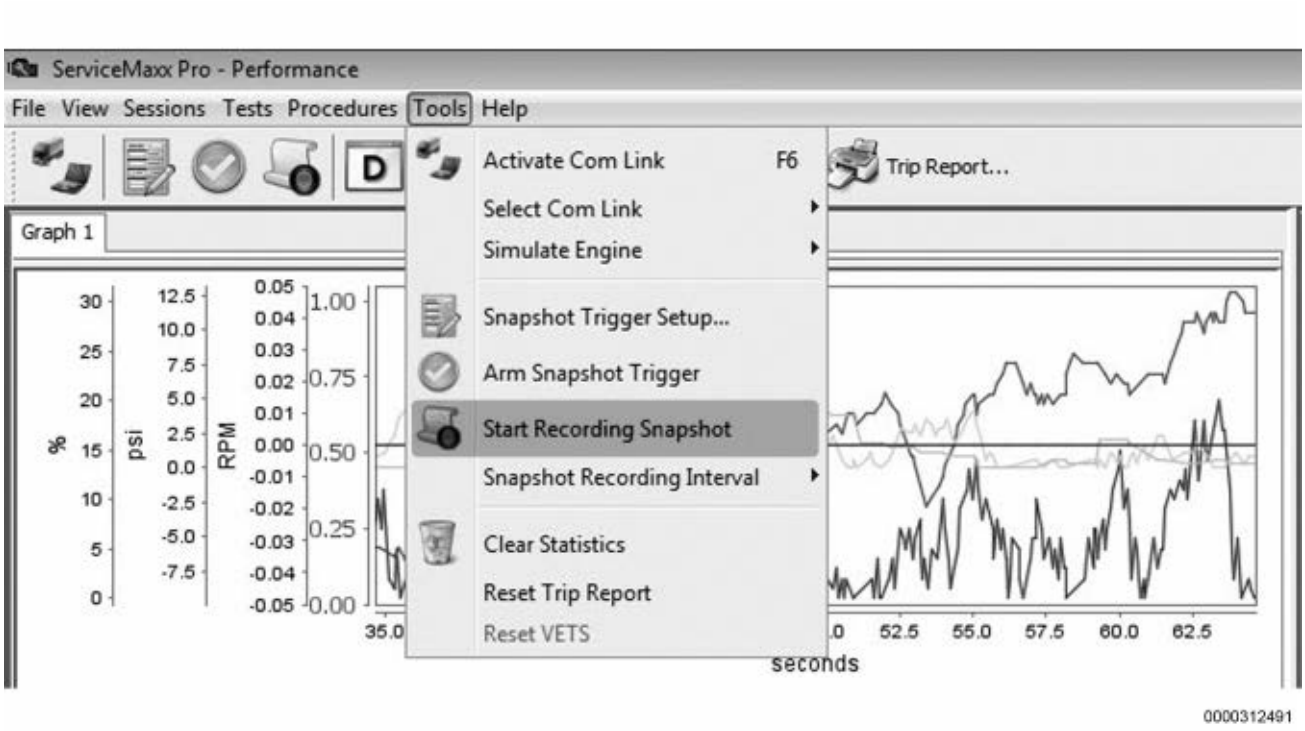


Figure 885 Tools - Recording Snapshot

4. In ServiceMaxx™ software, select Tools > Start Recording (Figure 885).
5. Start engine and idle for 20 seconds.
6. Press and hold accelerator pedal to floor for 20 seconds while listening and feeling for engine problems such as:
   - Engine does not accelerate smoothly
   - Imbalance or vibrations
   - Cylinders not firing or cylinders misfiring
7. Return to low idle.

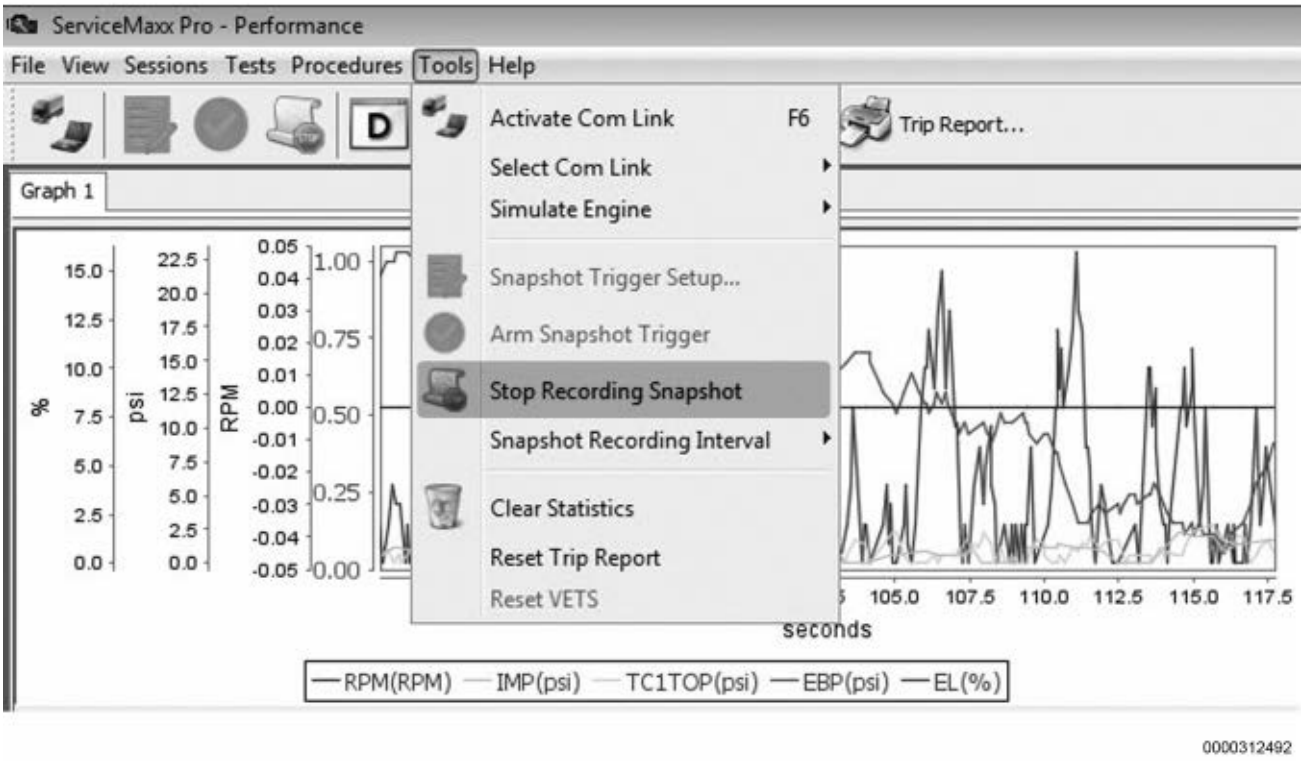


Figure 886 Menu – Tools

8. Select Tools > Stop Recording (Figure 886) and check the following signals against specifications:
   - Fuel Delivery Pressure (FDP)
   - Injection Control Pressure (ICP)
   - Exhaust Back Pressure (EBP)
   - Intake Manifold Pressure (IMP)
   - Diesel Particulate Filter Differential Pressure (DPFDP)
9. If any signal does not meet specifications, diagnose that system in appropriate section or manual.

Expected Outcome

Engine will accelerate smoothly, all signals will be within specifications, and no imbalance or misfire will be detected.

Follow-On Procedure

None

KOEO Output State High or Low

Overview

The Key-On Engine-Off (KOEO) Output State Test High or Low will command all actuators to their high or low position. This test allows users to diagnose actuator movement by commanding actuators high or low and monitoring signals in ServiceMaxx™ or using a multimeter to measure circuits and also to visually monitor movement on some actuators. This test does not display pass or fail results and user will need to cancel test before running any other test. The KOEO Standard Test must be performed before this test is allowed to run.

Actuators that cycle during this test:

- Exhaust Gas Recirculation (EGR) Valve
- Engine Throttle Valve Position (ETP)
- Turbocharger 2 Wastegate Position (TC2WG)
- Engine Injection Control Pressure Regulator (IPR)
- Electric Fuel Pump (EFP)

Tools Required

- Digital Multimeter (DMM)
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle diagnostic connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure

1. Perform KOEO Standard test (Figure 882).

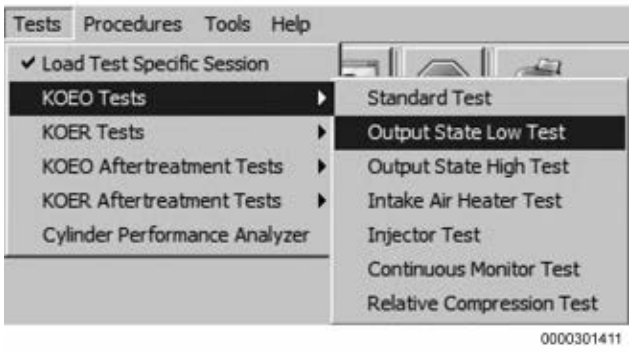


Figure 887 Menu – Select Test

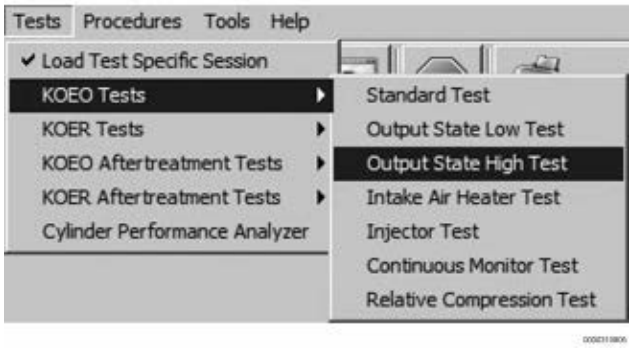


Figure 888 Menu – Select Test

2. Once test is complete, select Tests > KOEO Tests > Output State High Test (Figure 888) or select Tests > KOEO Tests > Output State Low Test (Figure 887).
3. Monitor signals, verify visual movement or make measurements as needed.
4. Allow test to run for a minimum of 30 seconds before stopping testing.

Expected Outcome

Actuators will cycle to their high or low state as commanded; signals will show the command to high or low state and remain steady while test is active.

Follow-On Procedure

None

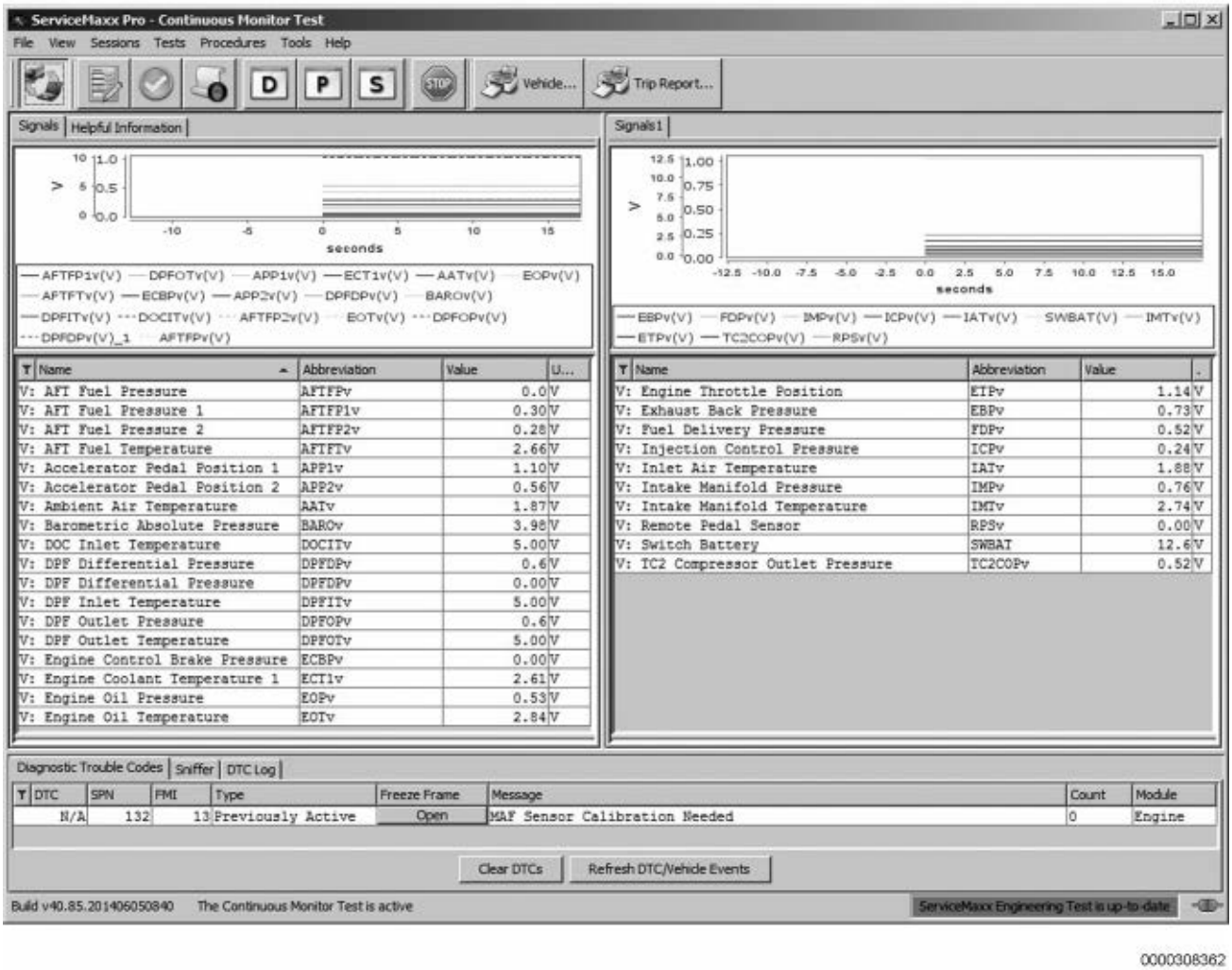
Continuous Monitor

Overview

The Key-On Engine-Off (KOEO) Continuous Monitoring – Intermittence Sensor Diagnostics test is used to detect sensor intermittent faults. During this test, sensor voltages are continuously monitored. This test provides a graphical view of all signals and allows the technician to detect intermittent spiking or monetary loss of signal. Perform this test while wiggling connectors, wiring, and harnesses of the suspected faulty component.

NOTE: A sensor fault that goes out of range high or low will cause the voltage signal to display Error. The Continuous Monitor Test will force all sensor voltage to display actual voltages.

NOTE: This test does not work on early calibrations. Out of Range HIGH and Out of Range LOW faults will display during this test until early 2015.



0000308362

Figure 889 KOEO Continuous Monitor Test Home Screen

Position Sensor Voltages are Monitored:

- Accelerator Pedal Position 1
- Accelerator Pedal Position 2
- Engine Throttle Position
- Remote Pedal Sensor (If equipped)

Pressure Sensor Voltages are Monitored:

- Aftertreatment (AFT) Fuel Pressure 1
- AFT Fuel Pressure 2
- Barometric Absolute Pressure
- Diesel Fuel Particulate (DPF) Differential Pressure
- DPF Outlet Pressure
- Engine Control Brake Pressure
- Engine Oil Pressure
- Exhaust Back Pressure
- Fuel Delivery Pressure
- Injection Control Pressure
- Intake Manifold Pressure
- Turbocharger 2 (TC2) Compressor Outlet Pressure

Temperature Sensor Voltages are Monitored:

- AFT Fuel Temperature
- Ambient Air Temperature
- Engine Coolant Temperature 1
- Engine Oil Temperature
- Exhaust Gas Temperature
- Intake Air Temperature
- Intake Manifold Temperature

Other Voltage Signals Monitored:

- Switched Battery

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.

Test Procedure

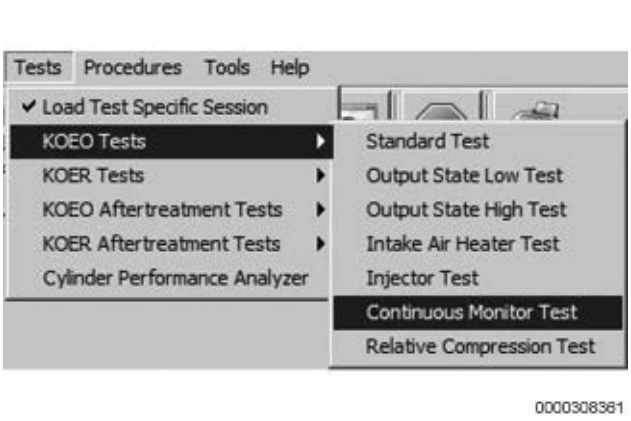


Figure 890 Menu – Select Test

1. Select Continuous Monitor (Figure 890) from drop down menu.

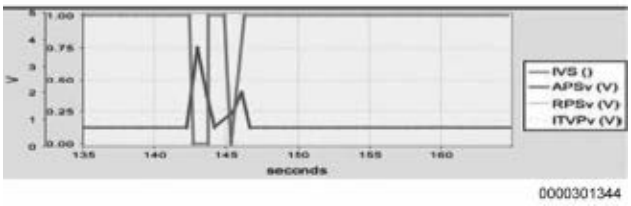


Figure 891 Voltage Spike

2. Monitor suspect voltage signal while wiggling the wiring harness and connectors. If the circuit is interrupted, the signal will spike.



Figure 892 Stop Test Button

3. Test will run until cancelled by pressing the Stop test button (Figure 892).

Follow-on Procedure

None

KOEO DEF Tank Heater Test

Overview

The Key-ON Engine-OFF (KOEO) Diesel Exhaust Fluid (DEF) Tank Heater Test is used to command the DEF tank heater on, allowing a service technician to measure the voltage output to the DEF tank heater control valve confirming the system is working correctly.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939-compliant Interface Cable

Equipment Conditions

None

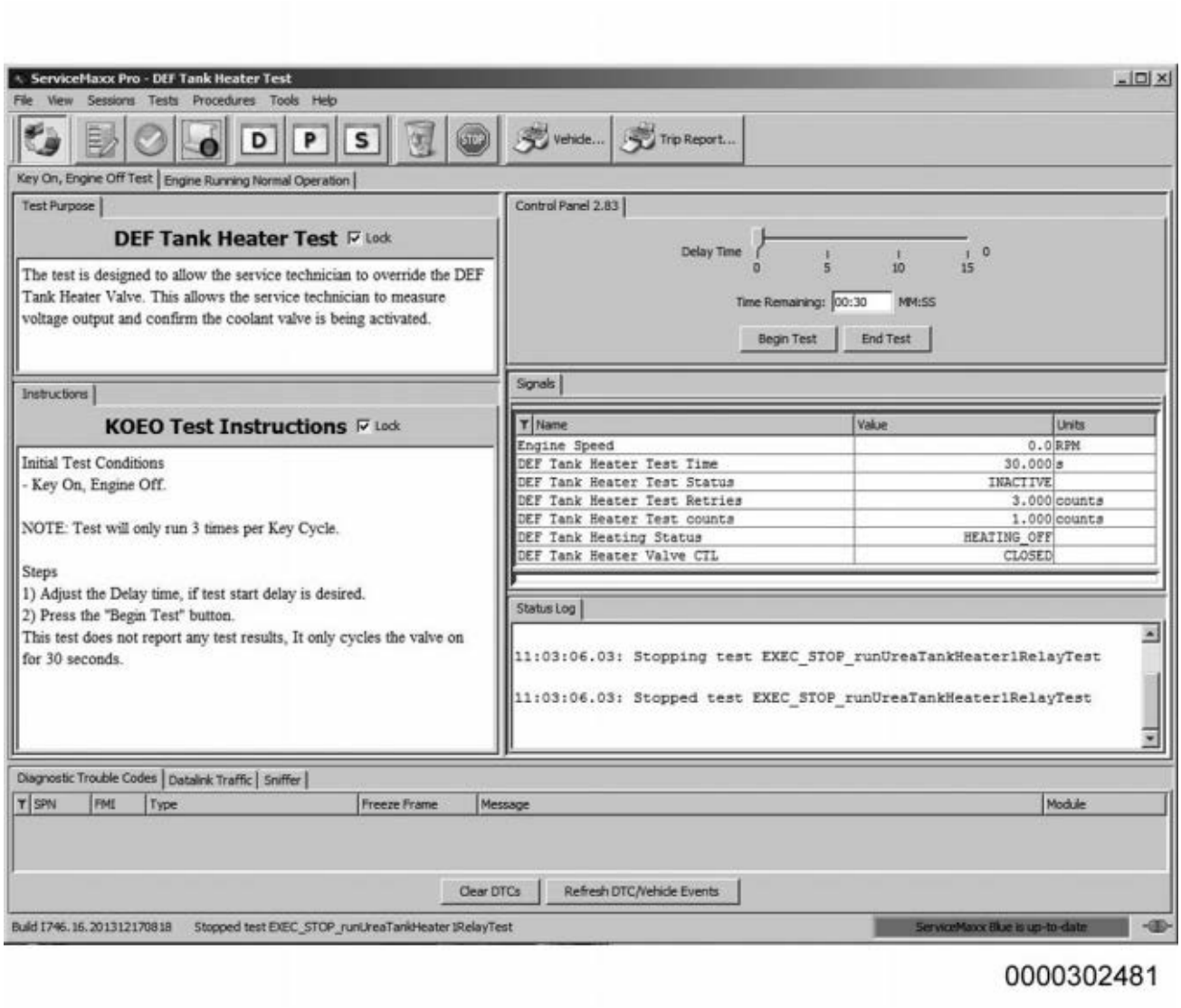


Figure 893 DEF Tank Heater Test

Test Setup

1. Key-ON Engine-OFF (KOEO).
2. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124).
3. Start ServiceMaxx™ software.

Test Procedure

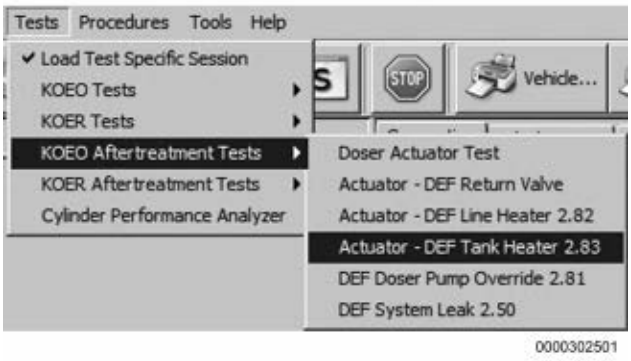


Figure 894 Select Test

1. Select KOEO Aftertreatment Tests, Actuator – Diesel Exhaust Fluid (DEF) Tank Heater (Figure 894) from the drop down menu.
2. The DEF tank heater session will load on the screen.

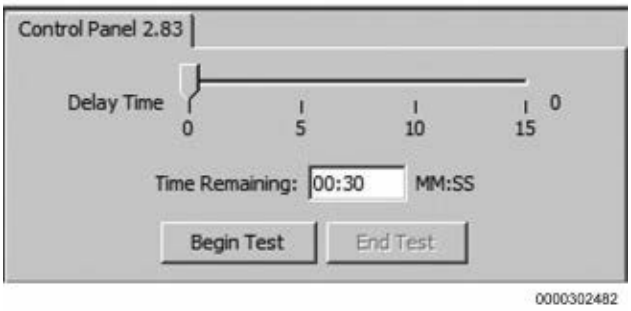


Figure 895 Begin Test button

3. Adjust the desired test delay amount (Figure 895), if any delay is needed.
4. Press the Begin Test button (Figure 895) to begin the test.
5. This test does not display pass or fail results.

Expected Outcome

The test will complete successfully.

Follow-On Procedure

None

KOEO Injector Test

Overview

The purpose of this test is to verify all 6 injectors are being electronically activated by the Engine Control Module (ECM). This test will activate all injectors at the same time, then active each individual injector in order (1, 2, 3, 4, 5 and 6) for 2 seconds with a 1 second pause in between. This is an audible test only (audible buzz sound) and will not activate any other codes.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

- None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure

NOTE: The Key-On Engine-Off (KOEO) Standard Test must be run before running this test.

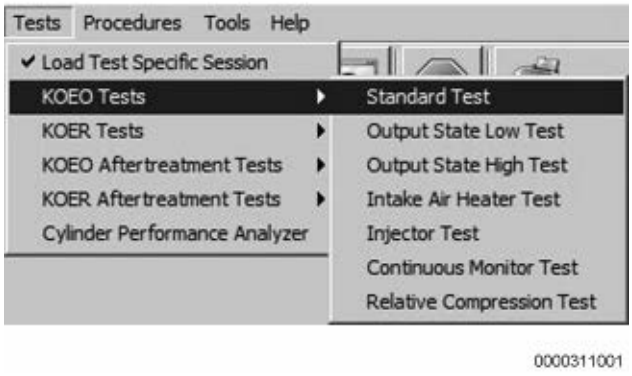


Figure 896 Menu — Select Test

1. Select KOEO Standard test (Figure 896) from the Tests drop-down menu.

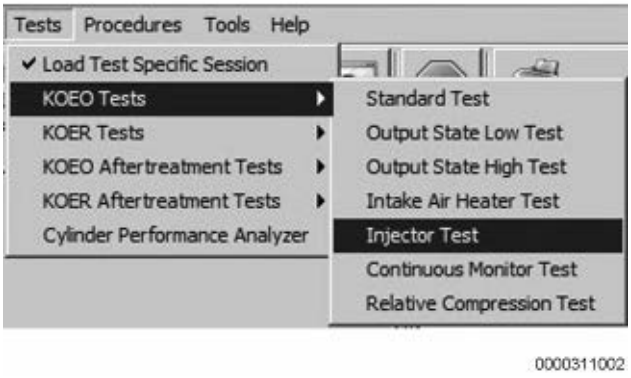


Figure 897 Menu – Select Test

NOTE: This is an audible test only and does not load a special session.

2. Select KOEO Injector Test (Figure 897) from drop-down menu.

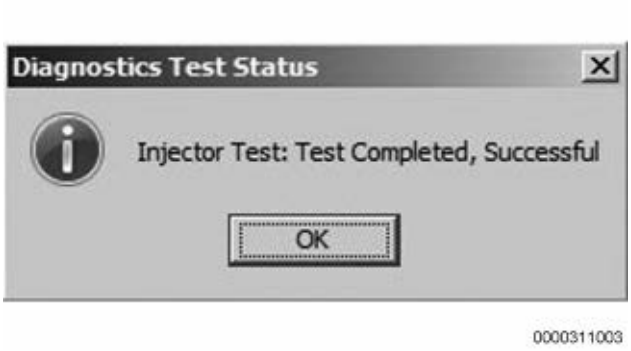


Figure 898 Menu – Test Complete

3. This test does not display pass or fail results and will display test complete (Figure 898) when finished.

Expected Outcome

Test will complete successfully, and audible buzz will be heard from each injector.

Follow-on Procedure

None

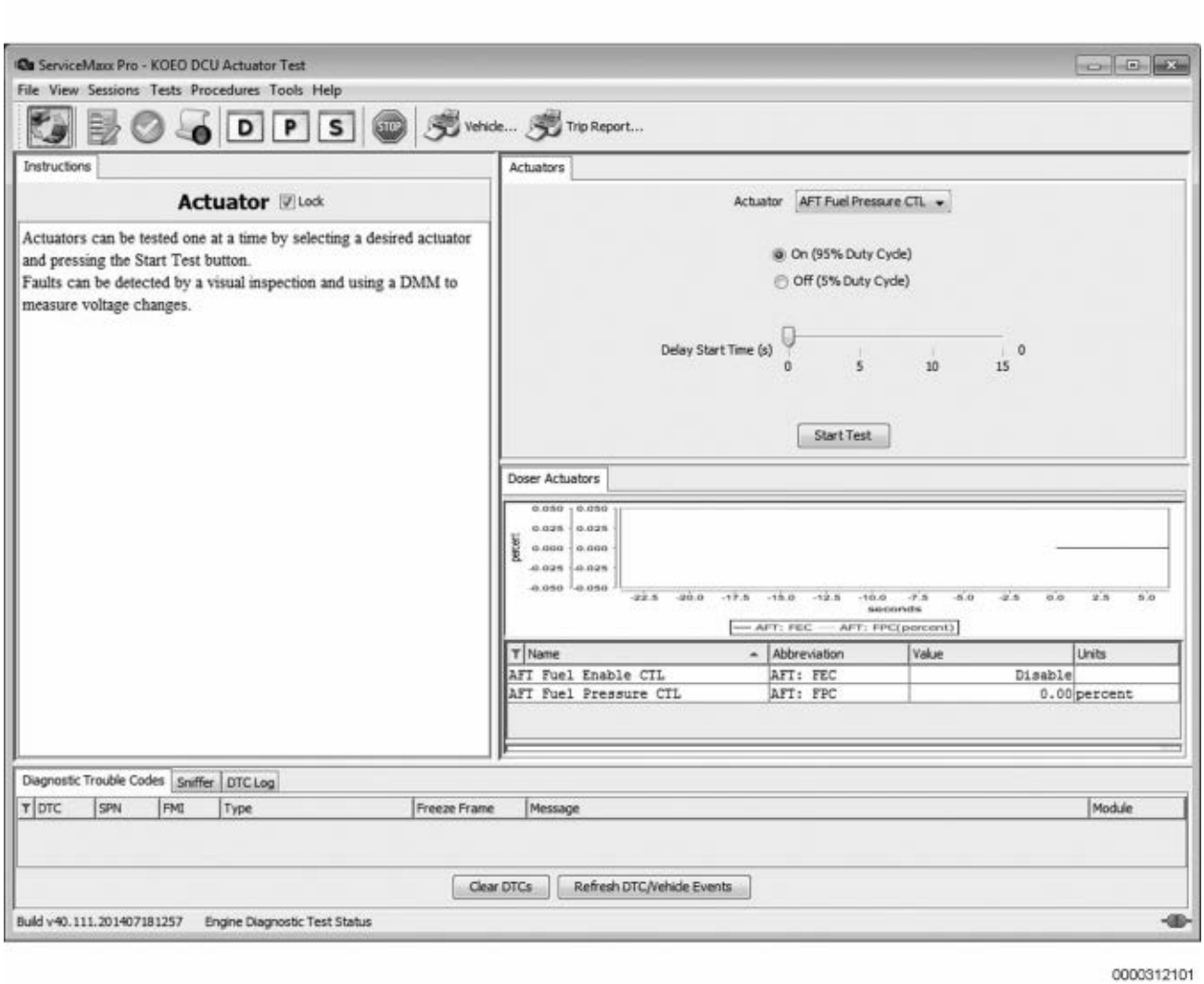
KOEO DCU Actuator Test – Actuator Output High and Low Diagnostics

Overview

The Key-On Engine OFF (KOEO) Doser Control Unit (DCU) Actuator test will enable the technician to cycle any actuator high or low. Some actuators have variable positions. A technician can use a Digital Multimeter (DMM) to measure changes in voltage or duty cycle, or visually monitor actuator movement while actuator is commanded.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software.
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



0000312101

Figure 899 Actuator Test

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start ServiceMaxx™ software.

Test Procedure

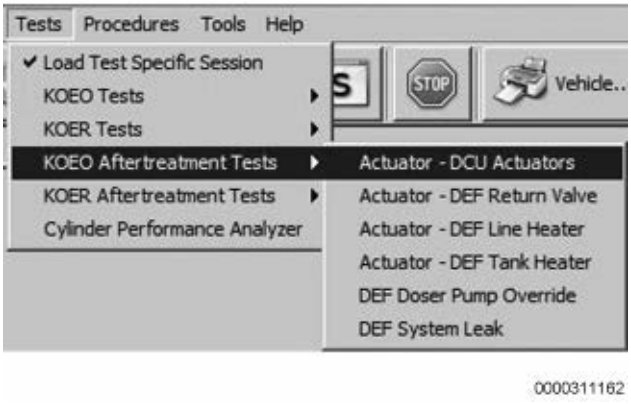


Figure 900 Menu – Select Test

1. Select Actuator - DCU Actuators from KOEO Aftertreatment Tests (Figure 900) drop-down menu.

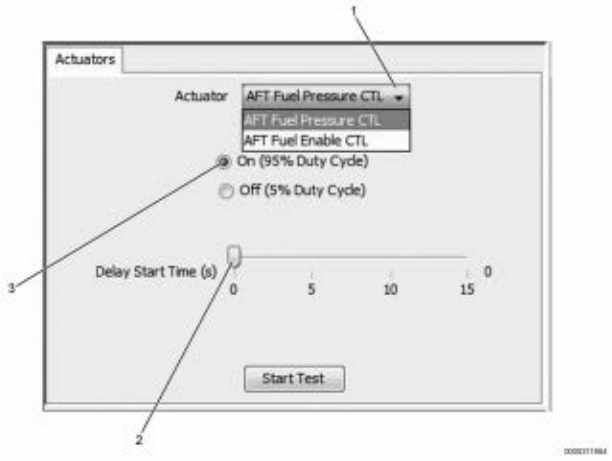


Figure 901 Actuator Control Panel

1. Actuator selection
2. Actuator start delay time
3. Actuator Duty Cycle control

2. Select desired actuator from control panel (Figure 901).
3. Steps 3-5 refer to Actuator Control Panel (Figure 901).

4. Adjust amount of duty cycle you wish to control.
5. Adjust delay test start time, if a delay start time is desired.
6. Press the Start Test button to begin the test.

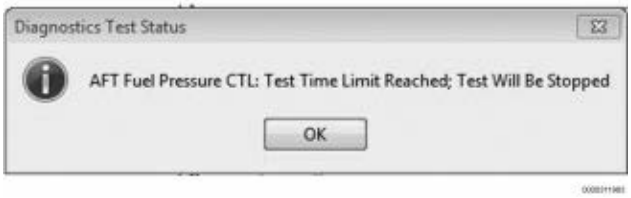


Figure 902 Test Complete

7. Actuator will cycle to commanded position for 5 seconds, before the Test Completed Successful (Figure 902) notification is displayed.

NOTE: This test does not display pass or fail results.

Expected Outcome

The test will complete successfully.

Follow-On Procedure

None

KOEO DEF System Leak Test

Overview

Diesel Exhaust Fluid (DEF) System Leak Test is used to prime DEF system and hold pressure so the system can be checked for leaks. This test does not display pass or fail results.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start and log in to ServiceMaxx™ software.

Test Procedure

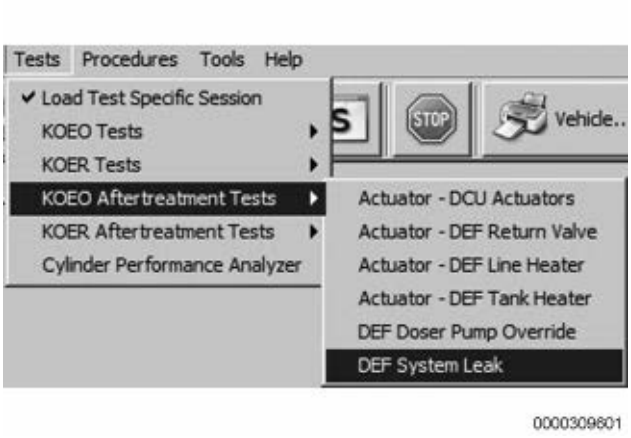


Figure 903 Menu – Select Test

1. Tests > KOEO Aftertreatment Tests > DEF System Leak (Figure 903).

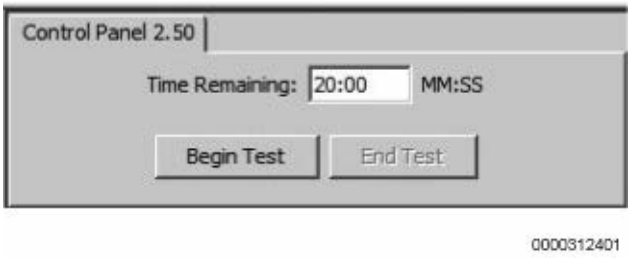


Figure 904 Menu – Begin Test button

2. Select Begin Test button (Figure 904) to start testing.
3. Test will run for 20 minutes, but can be cancelled at any time.

Expected Outcome

DEF System Leak Test will prime and hold pressure on the system allowing for leaks to be detected visually.

Follow-On Procedure

None

KOEO DEF Line Heater Test

Overview

The Key-On Engine-Off (KOEO) Diesel Exhaust Fluid (DEF) Line Heater Test is used to command DEF Line Heaters ON, allowing a service technician to measure voltage output to DEF Line heaters while confirming system is working correctly.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start and log in to ServiceMaxx™ software.

Test Procedure

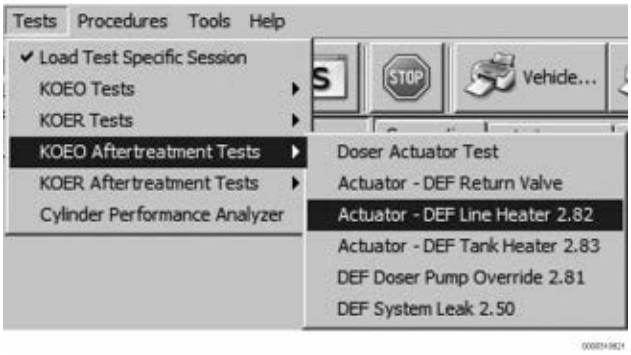


Figure 905 Menu – Select Test

1. Select KOEO Aftertreatment Test > Actuator – DEF Line Heater (Figure 905) from drop-down menu.
2. DEF Line Heater session will load on the screen.

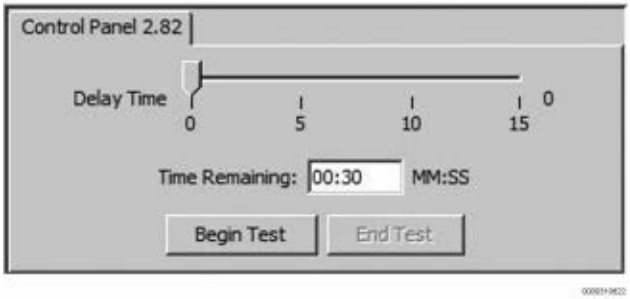


Figure 906 Menu – Begin Test button

3. Adjust desired test delay amount, if any delay is needed (Figure 906).
4. Press Begin Test button to begin test (Figure 906).
5. This test does not display pass or fail results.

Expected Outcome

None

Follow-On Procedure

None

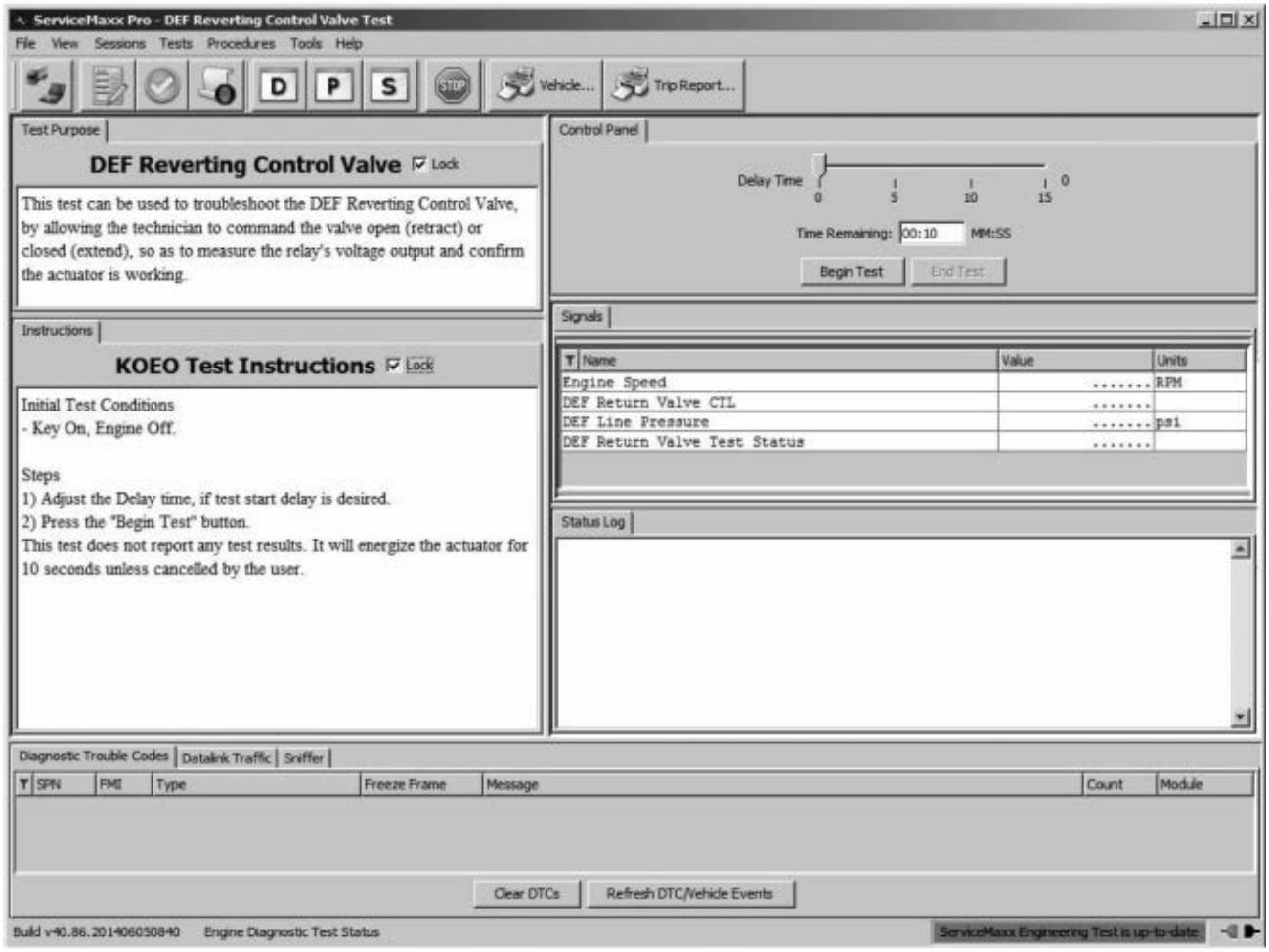
KOEO DEF Reverting Control Valve Test

Overview

The Key-ON Engine-OFF (KOEO) Diesel Exhaust Fluid (DEF) Reverting Control Valve Test is used to command the DEF reverting valve on, allowing a service technician to measure the voltage output to the valve, which confirms the system is working correctly.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)



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Figure 907 DEF Reverting Control Valve Test

Test Setup

1. Key-ON Engine-OFF (KOEO).

2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Key ON. Log in to ServiceMaxx™ software.

Test Procedure

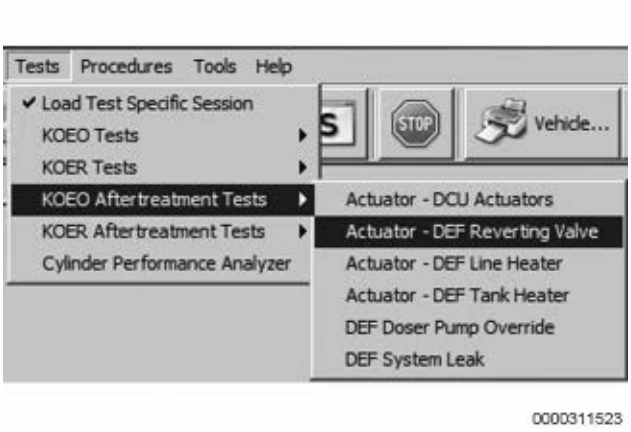


Figure 908 Select Test

1. Select KOEO Aftertreatment Test, Actuator – DEF Reverting Valve (Figure 908) from the drop-down menu.
2. The DEF Reverting Valve test session will load on the screen.

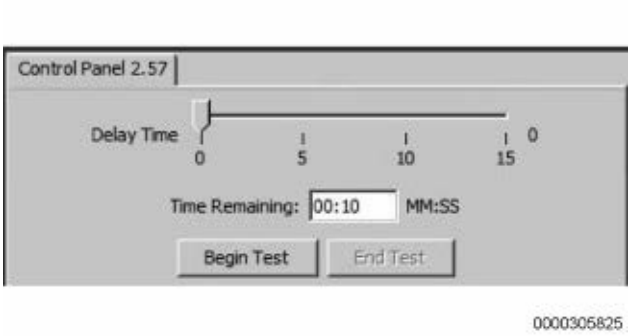


Figure 909 Begin Test Button

3. Adjust the desired test delay (Figure 909) amount, if any delay is needed.
4. Press the Begin Test button (Figure 909) to begin the test.
5. This test does not display pass or fail results.

Expected Outcome

The test will complete successfully.

Follow-On Procedure

None

KOEO DEF Supply Pump Override Test

Overview

Key-On Engine-Off (KOEO), Diesel Exhaust Fluid (DEF) Supply Pump Override Test is used to measure DEF flow rate for a fixed amount of time to ensure proper operation.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Conditions

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Remove Diesel Exhaust Fluid Dosing Unit (DEF: DU) from exhaust pipe and place it into a clean, graduated cylinder or jar.
4. Log in to ServiceMaxx™ software.

Test Procedure

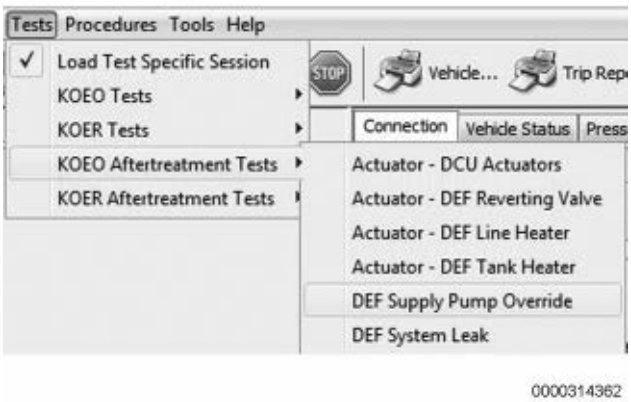


Figure 910 Menu – Select Tests

1. Select Tests > KOEO Aftertreatment Tests > DEF Supply Pump Override.



Figure 911 Begin Test button

2. Once session is loaded, click Begin Test button.
3. After you click Begin Test button, a new popup message will appear. Verify conditions are acceptable before starting test. If Doser is safely placed into a fluid measuring container, click Begin Test button again to proceed.
4. Test will run for 6 minutes.
5. When test is complete, measure amount of Diesel Exhaust Fluid (DEF) injected into container.

Expected Outcome

Test will run successfully, injecting 100 ml of Diesel Exhaust Fluid (DEF) into measuring container.

Follow-On Procedure

None

KOEO Relative Compression Test

Overview

The KOEO Relative Compression Test measures cylinder balance in order to determine cylinder integrity. The test results are presented in graphical or numerical displays. The graphs or numbers should be approximately the same, indicating well balanced and equal cylinders.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

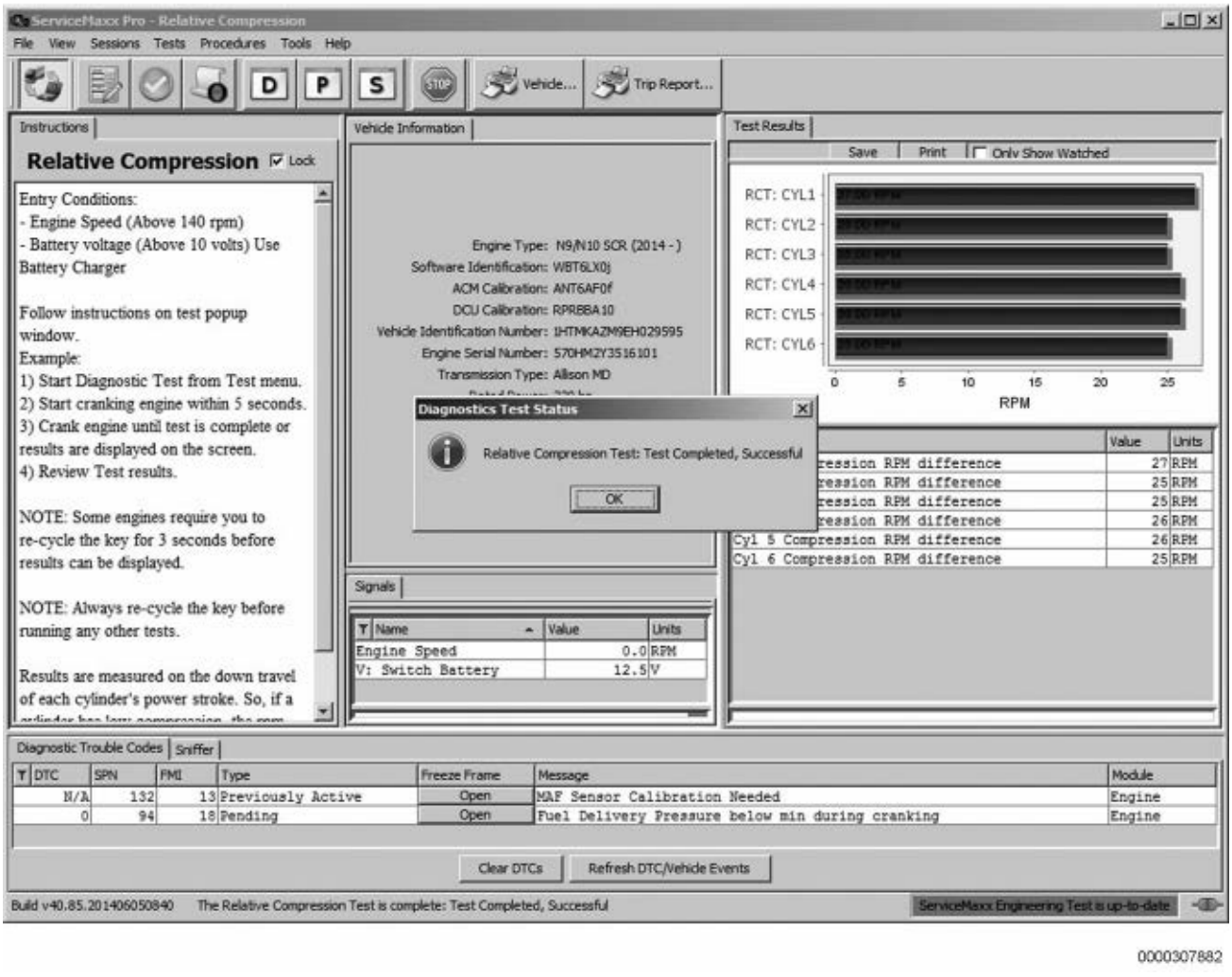


Figure 912 Relative Compression Test

Test Setup

1. Key-On Engine-Off (KOEO).

2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Batteries must be charged (Use Battery charger if necessary).

Test Procedure

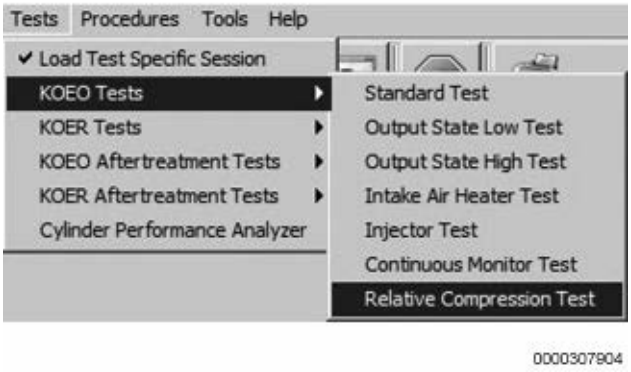


Figure 913 Menu — Select Test

1. Select Relative Compression Test (Figure 913) from the KOEO Tests drop-down menu.

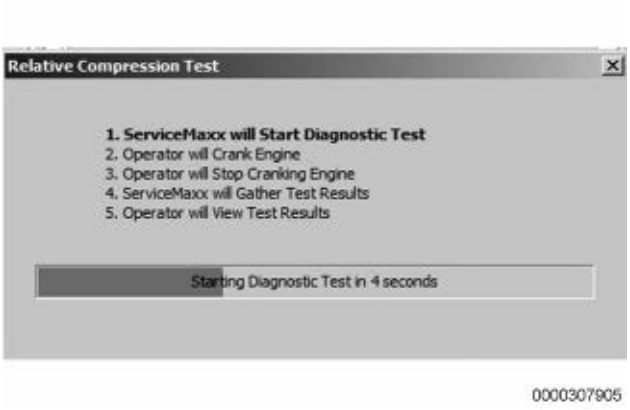


Figure 914 Test Instructions Popup Panel

2. Follow the instructions on the popup test panel (Figure 914) .

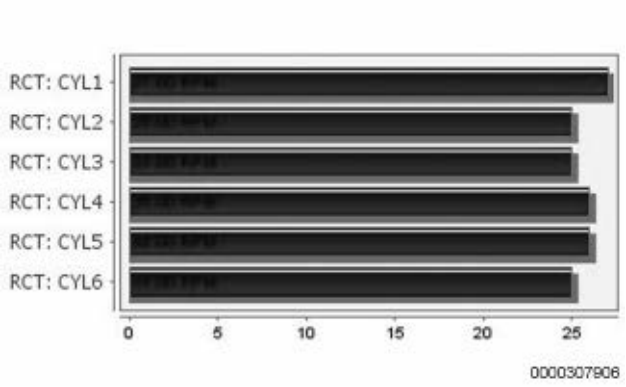


Figure 915 Test Results

3. Results are measured on the down travel of each cylinder's power stroke (Figure 915). A cylinder with low compression will be significantly lower then the others.

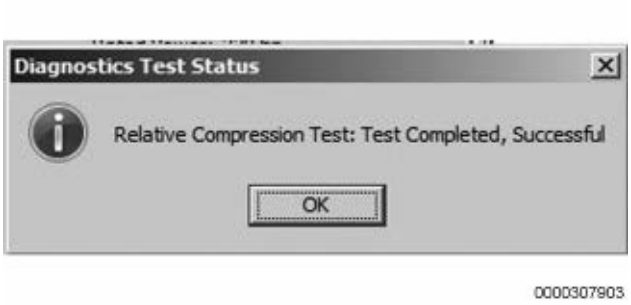


Figure 916 Test Complete

4. When test is complete (Figure 916), review test results.

Expected Outcome

Test will complete successfully

Follow-On Procedure

None

KOEO SCR Faults Reset Request Procedure

Overview

After diagnosing and repairing Selective Catalytic Reduction (SCR) faults, SCR Faults Reset Parameter will have to be reprogrammed.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939-compliant interface cable

Equipment Condition

- None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Start and log in to ServiceMaxx™ software.

Test Procedure

1. Clear Diagnostic Trouble Code (DTCs) if any are displayed.



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Figure 917 Sessions Menu

2. Sessions > Programming (Figure 917).

3. Click on Service Interval tab.

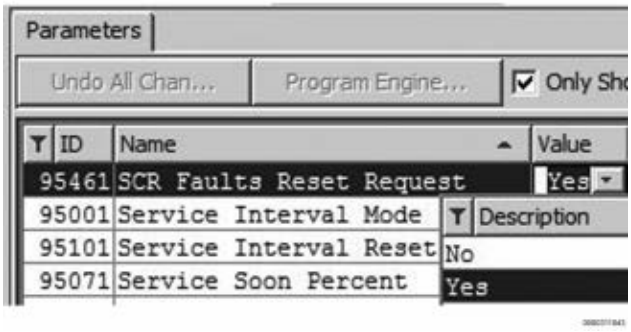


Figure 918 Change Parameters Value

4. Change value on 95461 SCR Faults Reset Request from No to Yes (Figure 918).

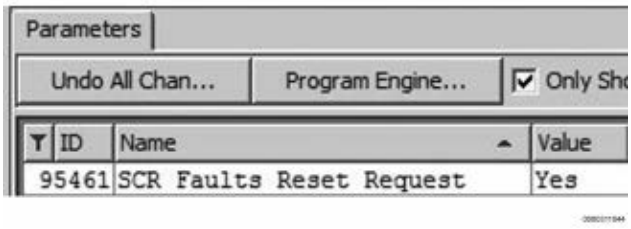


Figure 919 Program Engine

5. Click Program Engine Button (Figure 919).
6. When programming is successful, turn Key OFF for minimum of 15 seconds.
7. Turn Key ON.
8. Clear any Diagnostic Trouble Codes (DTCs).

Expected Outcome

Engine will program successfully and SCR faults will be reset.

Follow-On Procedure

None

KOEO Engine Cranking Test

Overview

Monitors engine systems as the engine is cranked to determine if systems are able to meet minimum starting requirements.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

GRAPHIC PLACE HOLDER

0000300422

1. Key-On Engine-Off (KOEO).

2. Connect Electronic Service Tool (EST) with ServiceMaxx sotware to vehicle diagnostic connector.
3. Log in to ServiceMaxx™.

Procedure

GRAPHIC PLACE HOLDER

0000300422

1. Select Sessions > Hard Start – No Start.
2. Select Tools > Start Recording Snapshot.
3. Crank engine for 10 seconds.
4. Select Tools > Stop Recording Snapshot.
5. Verify the following signals meet specification:

   Signals:

   - Switch Battery (SWBAT)
   - Engine Speed (RPM)
   - Injection Control Pressure (ICP)

- Fuel Delivery Pressure (FDP)
- Exhaust Back pressure (EBP)

Expected Outcome

All signal values meet specification.

Follow-on Procedure

None

Engine Running Tests

KOER Air Management Test

Overview

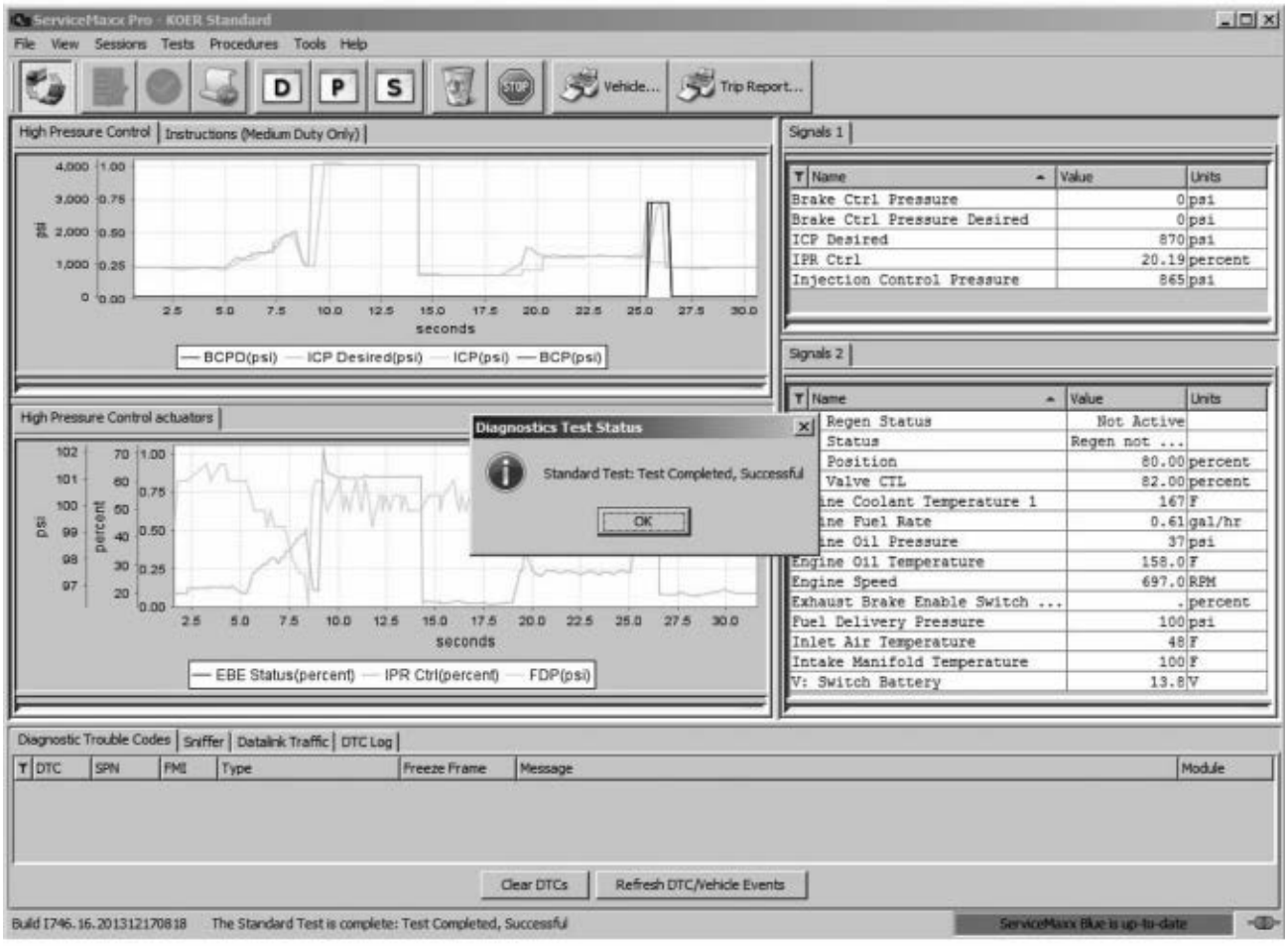
Tests performance of the Exhaust Gas Recirculation (EGR) valve by measuring changes in Mass Air Flow (MAF) through the MAF sensor and sets fault codes as necessary.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Conditions

None



0000310906

Figure 922 KOER Standard Test

Test Setup

1. Key-On Engine-Running (KOER).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Run engine until Engine Coolant Temperature 1 (ECT1) is above 158°F (70°C).

Test Procedure

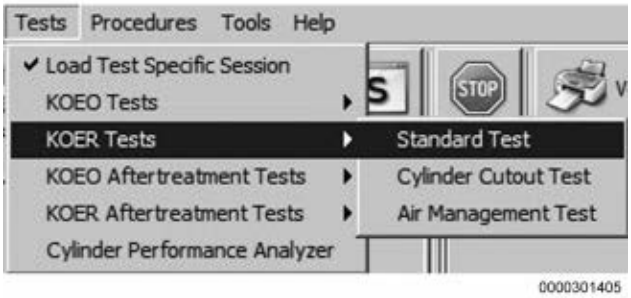


Figure 923 Select Test

1. Perform Key-On Engine-Running (KOER) Standard Test (page 2181).
2. After test is complete, select Tests > KOER Tests > Air Management Test.
3. Follow on screen instructions.



Figure 924 Test Complete

Expected Outcome

Test runs successfully, and no fault codes are set.

Follow-On Procedure

None

Air Management System Graph (GOOD)

Overview

This graph shows normal operation of the Air Management System (AMS) during the Air Management Test (AMT). The AMT gives pass or fail results. It allows the user to validate the AMS by monitoring the effects each actuator has on Intake Manifold Pressure (IMP). IMP is normally between 2 psi (14 kPa) to 6 psi (41 kPa) on engine ramp up during AMT. If the Exhaust Gas Recirculation (EGR) valve is not operating as designed, IMP will not respond to changes in EGR valve position. When this occurs, excess soot will be generated by the engine causing frequent regeneration of the aftertreatment system.

When EGR valve is commanded ON, verify Intake Manifold Pressure (IMP) signal value drops. When EGR valve is commanded ON, verify Mass Air Flow (MAF) Mean Value (MMV) drops. Calculate the difference between MMV at a high point and a low point, then compare to the table below.

NOTE: EGR valve position will never read less than 35% and is considered closed.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

Air Management Test Setup

Engine	MAF Mean Value	Tolerance
N9	1000	Less than 740 Fails AMS Test
N10	1130	Less than 850 Fails AMS Test

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Perform air management test (if not already done and saved).

Test Procedure

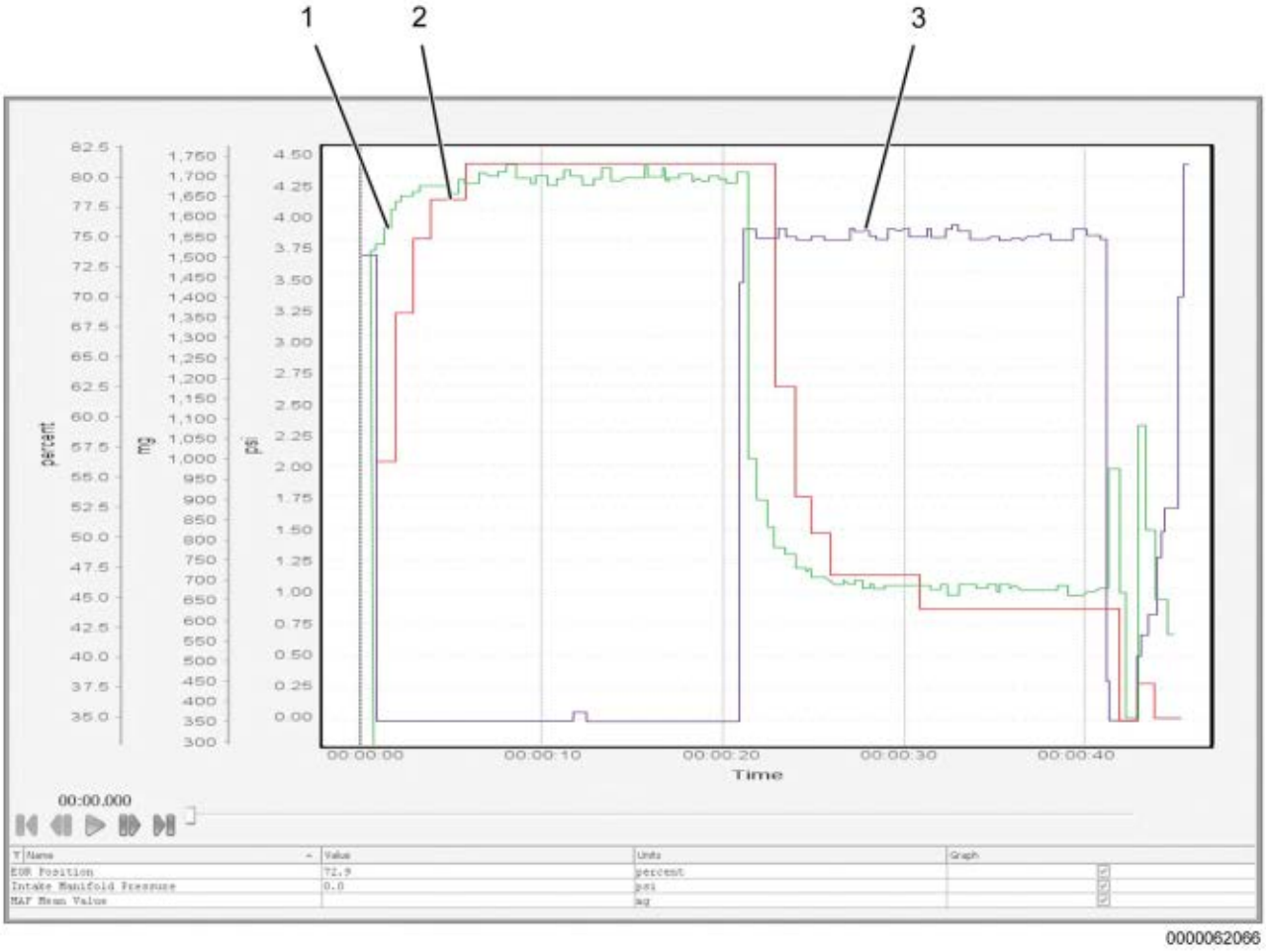


Figure 925 Air Management System Graph (Good)

1. Mass Air Flow Mean Value (MAF)
2. Intake Manifold Pressure (IMP)
3. Exhaust Gas Recirculation Valve Position (EGR)

1. Compare graph information with recorded data from test.
2. When EGR valve is commanded ON, verify IMP signal value drops.

Expected Outcome

A properly operating air management system graph will match this graph.

Follow-On Procedure

None

Air Management System Graph (BAD)

Overview

This graph shows an Air Management System (AMS) not operating as designed during the Air Management Test (AMT). The AMT gives pass or fail results. It allows the user to validate the AMS by monitoring the effects each actuator has on Intake Manifold Pressure (IMP). IMP is normally between 2 psi (14 kPa) to 6 psi (41 kPa) on engine ramp up during AMT. If the Exhaust Gas Recirculation (EGR) valve is not operating as designed, IMP will not respond to changes in EGR valve position. Excess soot will then be generated by the engine causing frequent regeneration of the aftertreatment system.

When EGR valve is commanded ON, verify Intake Manifold Pressure (IMP) signal value drops. In this graph, IMP does not drop when EGR valve is commanded ON.

NOTE: EGR valve position will never read less than 35 percent and is considered closed.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Perform Air Management Test (AMT) if not already done and saved.

Test Procedure

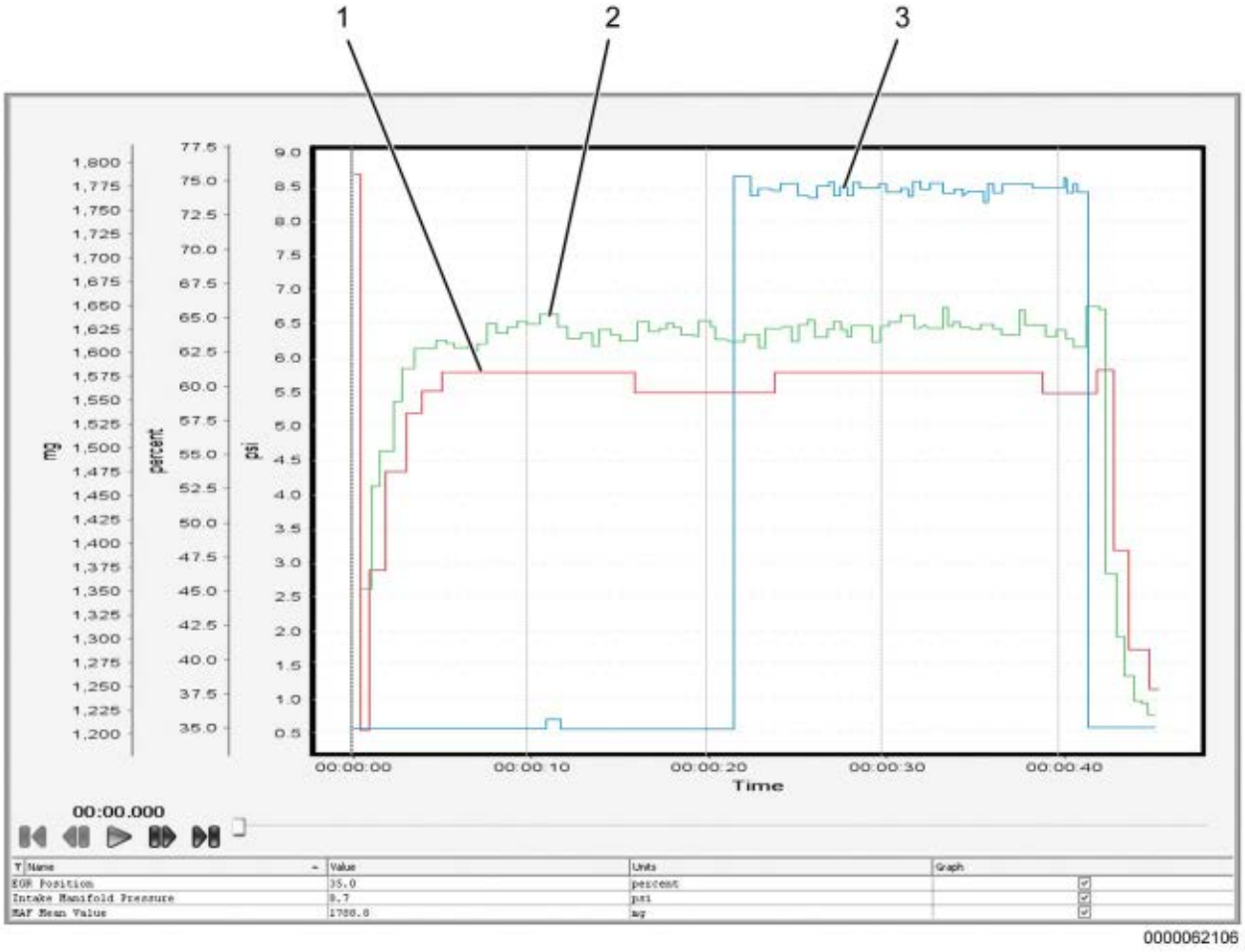


Figure 926 Air Management System Graph (Bad)

1. Intake Manifold Pressure (IMP)
2. Mass Air Flow (MAF)
3. Exhaust Gas Recirculation Valve (EGRV)

1. Compare graph information with recorded data from test.

Expected Outcome

An improperly-operating AMS graph will match this graph.

Follow-On Procedure

None

KOER Standard Test

Overview

The Key On, Engine Running (KOER) Standard Test verifies performance of the Injection Control Pressure (ICP) System. During this test, engine speed increases to 1500 RPM and the Engine Control Module (ECM) commands the Injection Pressure Regulator (IPR) valve to control ICP. The ICP Desired signal is the pressure the ECM commanding. The ECM will command 4000 psi, then 1000 psi. The ECM monitors the ICP sensor (Actual pressure) to validate the system's ability to meet ICP desired.

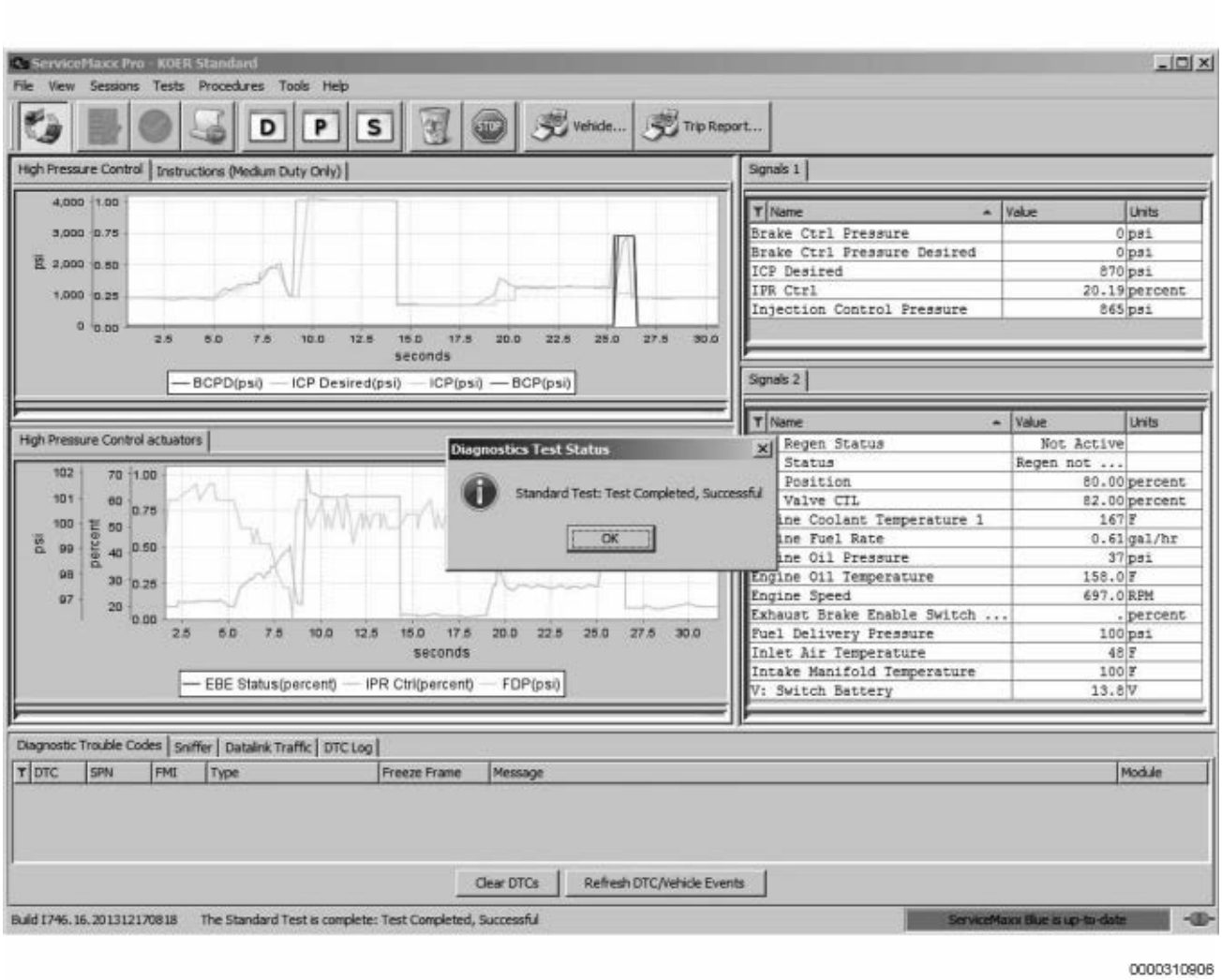
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939-Compliant Interface Cable

Equipment Conditions

- Engine Speed (below 700 RPM)
- Engine Coolant Temperature 1 (above 158°F 70°C)
- Vehicle Not Moving
- Accelerator Pedal Position (0%)
- Brake Pedal (Released)
- Clutch Pedal (Released)

Test Setup



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Figure 927 KOER Standard Test

1. Key-On Engine-Running (KOER).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.
4. Start engine and warm Engine Coolant Temperature (ECT) above 158°F (70°C).

Test Procedure

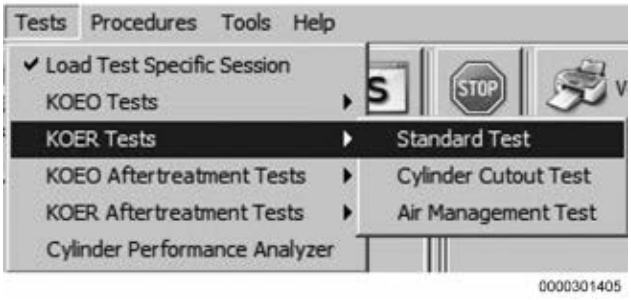


Figure 928 Menu — Select Test

1. Select Key-On Engine-Running (KOER) Standard Test (Figure 928) from the Test drop down menu.



Figure 929 Test Complete

2. This test does not display pass or fail results and will display test complete (Figure 929) when finished.

Expected Outcome

Test will complete successfully.

Follow-On Procedure

None

KOER Cylinder Cutout Test

Overview

The Key-On Engine-Running (KOER) Cylinder Cutout Test is an audible test only. This test can be used to help pin-point cylinder imbalance issues, by disabling one injector at a time while monitoring effects on engine idle quality. This test must not be used to validate performance of injectors. The Cylinder Performance Analyzer (CPA) Tools is the required tool for Misfire Diagnostics. This test does not display pass or fail results and will display test complete each time an injector is enabled.

Tools Required

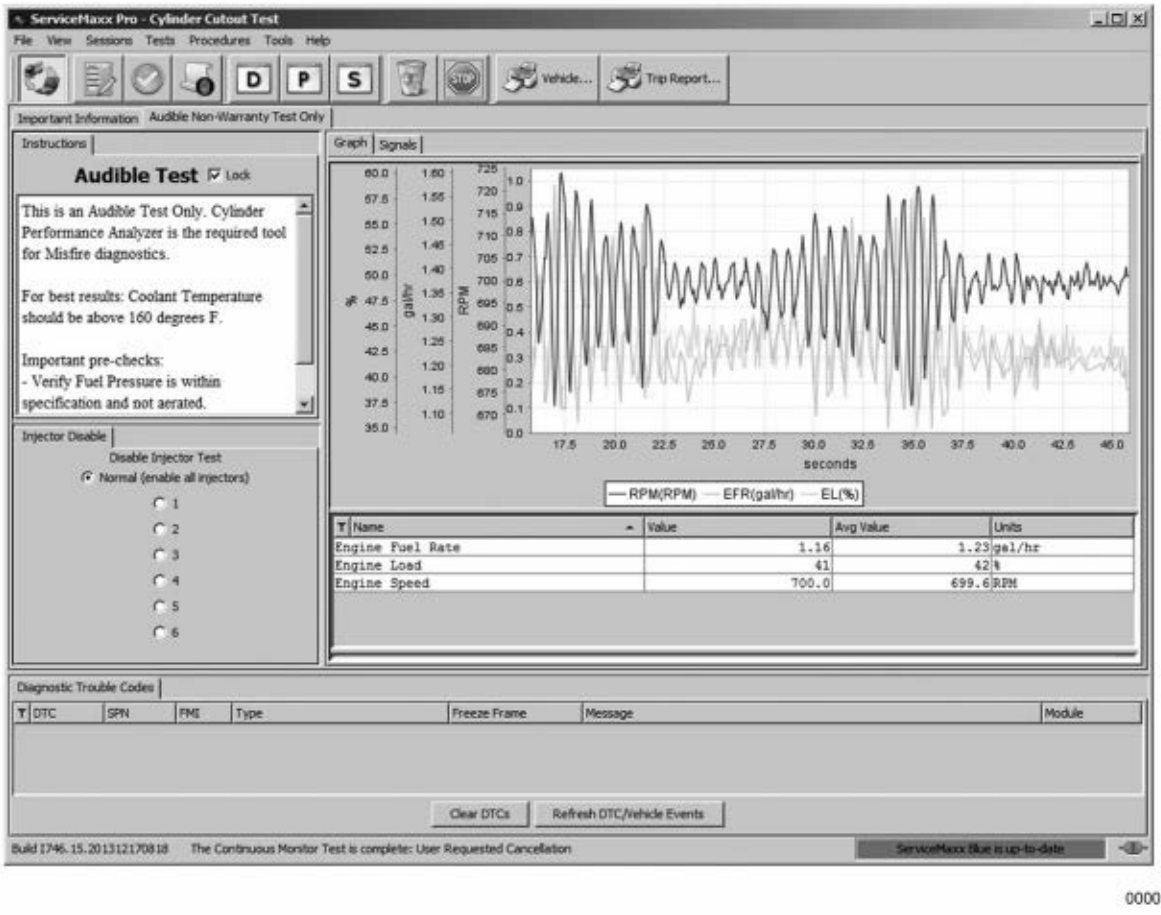
- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939-Compliant Interface Cable

Equipment Condition

- Engine Speed (below 700 RPM)
- Vehicle Not Moving
- Accelerator Pedal Position (0%)
- Brake Pedal (released)
- Clutch Pedal (released)

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).

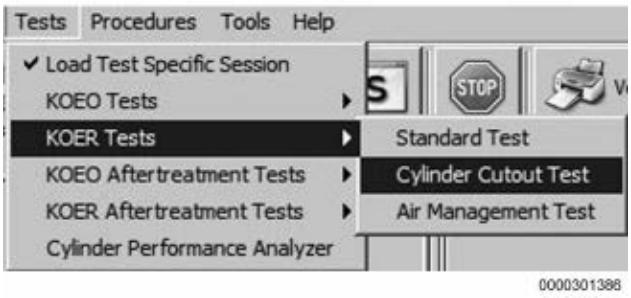


0000333801

Figure 930 Cylinder Cutout Test Home Screen

3. Log in to ServiceMaxx™ software (page 2096).

Test Procedure



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Figure 931 Menu – Select Test

1. Start engine.

2. Select Tests > KOER Tests > Cylinder Cutout Test (Figure 931).

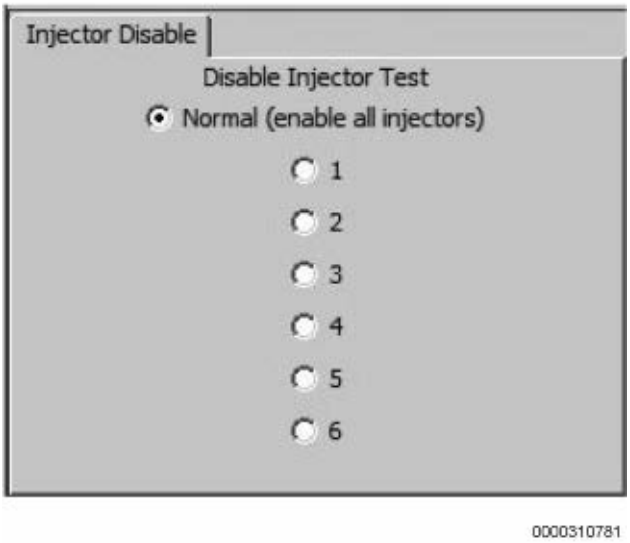


Figure 932 Test Control Panel

3. Injectors are disabled by clicking on desired injector from control panel (Figure 931).

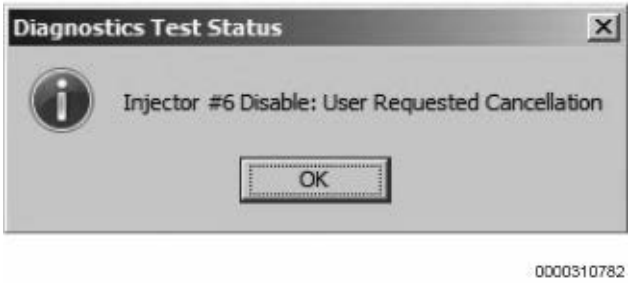


Figure 933 Test Complete

Expected Outcome

The engine will lose RPM and an audible change will be heard every time an injector is disabled.

Follow-on Procedure

None

KOER DSI System Test

Overview

The Key-On Engine-Running (KOER) Down Stream Injection (DSI) System Test can be used to validate performance of the DSI system.

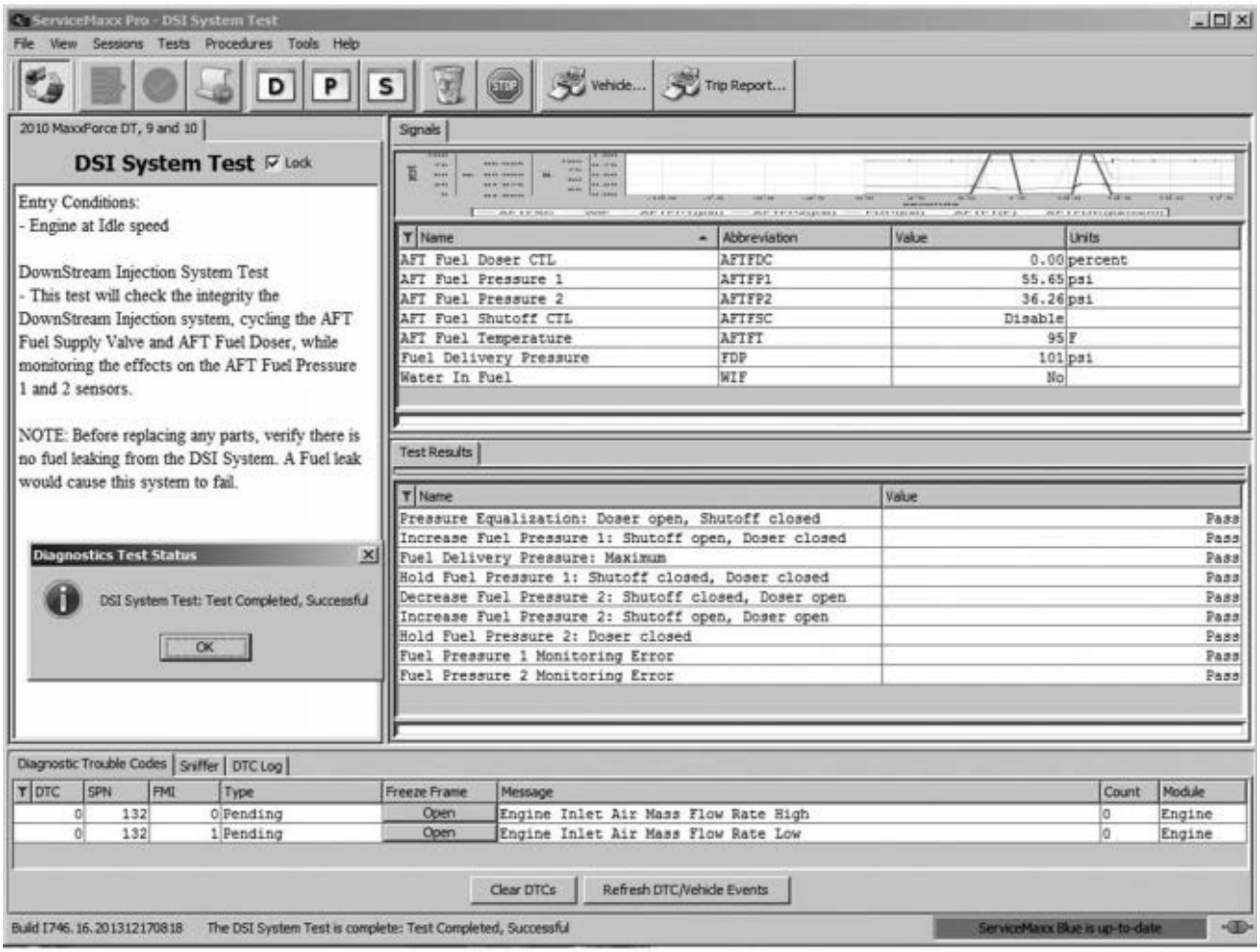


Figure 934 KOER DSI System Test

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Conditions

NOTE: The conditions below are shown how they should be displayed on ServiceMaxx™ software screen.

1. Engine speed (below 700 RPM).
2. Vehicle not moving.
3. Accelerator pedal position (0%).
4. Brake pedal (Release).
5. Clutch pedal (Release).

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124).
3. Start and log in to ServiceMaxx™ software.

Test Procedure

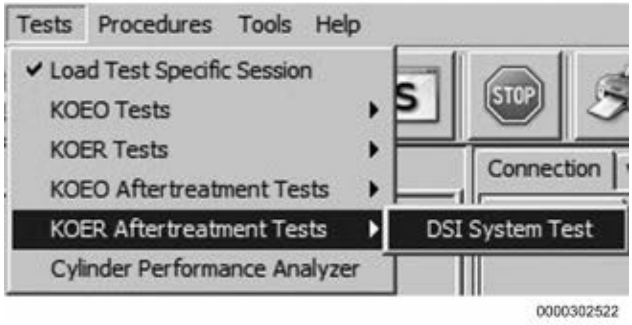


Figure 935 Menu – Select Test

1. Select KOER Aftertreatment Tests > DSI System Test (Figure 935) from test drop down menu.

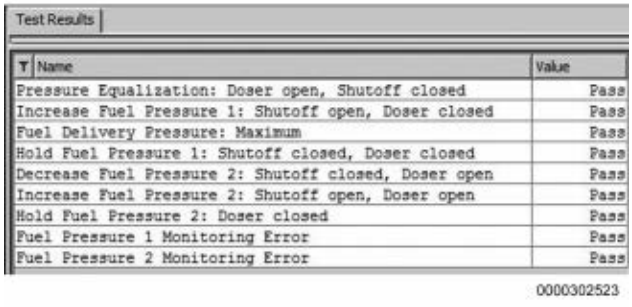


Figure 936 Test Results

2. The test will validate the performance of DSI system (Figure 936), by cycling Aftertreatment Fuel Enable Control (AFT: FEC) and Aftertreatment Fuel Pressure Control (AFT: FPC), while monitoring the effects on Aftertreatment Fuel Pressure 1 (AFT: FP1) and Aftertreatment Fuel Pressure 2 (AFT: FP2) sensors (Figure 936).
3. The test will display test results listed in result window during session (Figure 936).

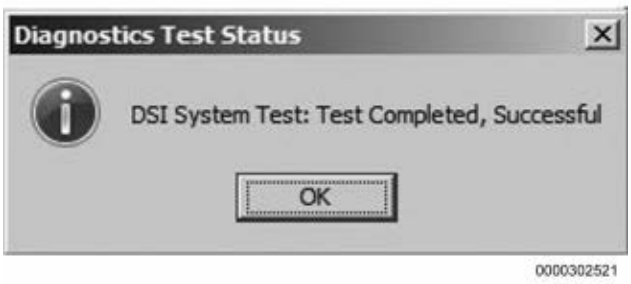


Figure 937 Test Complete

4. Test complete popup is also displayed indicating test has completed successfully (Figure 937).

Expected Outcome

Key-On Engine-Running (KOER) test will complete without any problems occurring.

Follow-On Procedure

None

KOER DSI Deaeration Procedure

Overview

The Key-On Engine-Running (KOER) Down Stream Injection (DSI) Deaeration Procedure can be used to purge air from the system after the fuel system was opened from a previous repair.

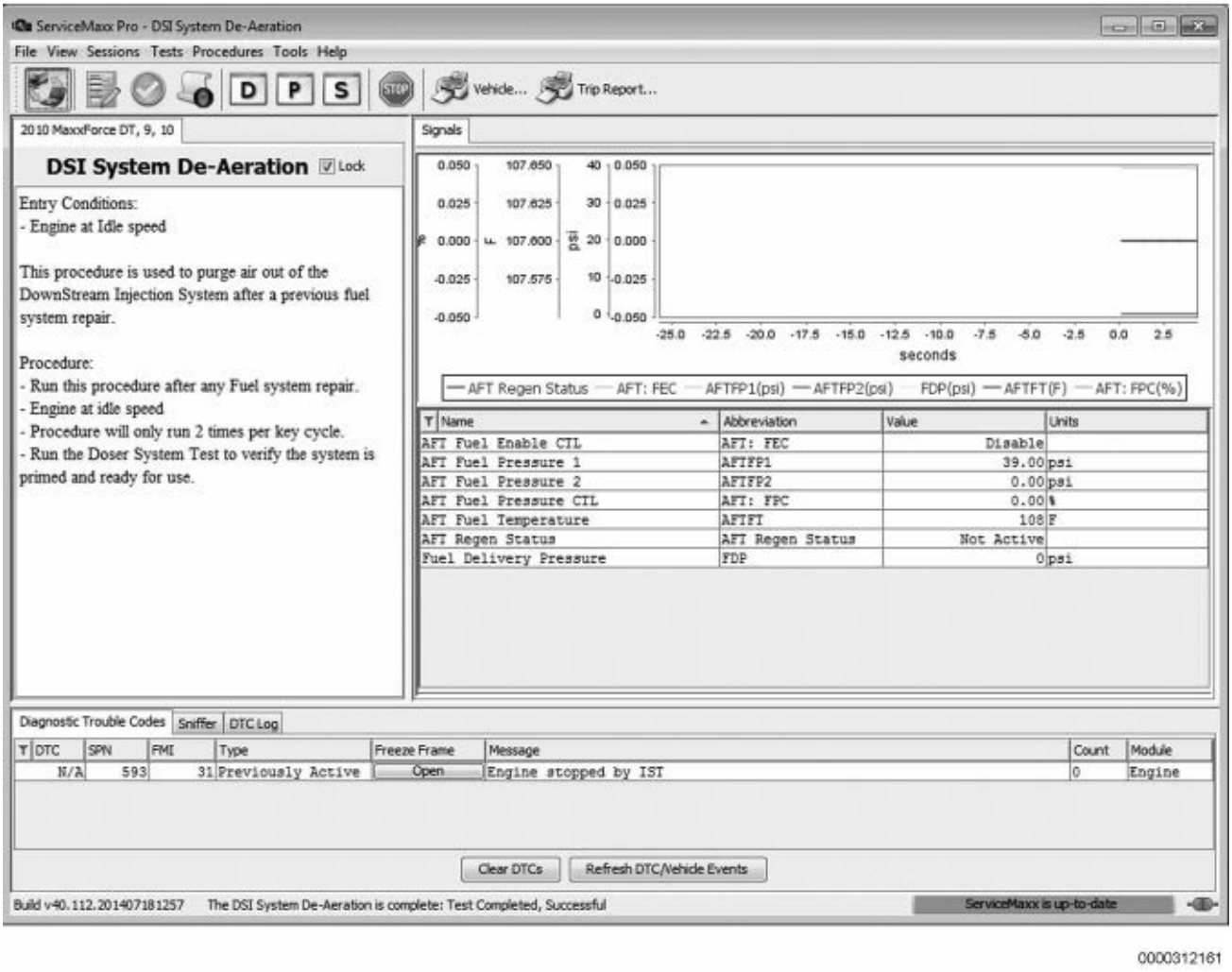
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

NOTE: The conditions below are shown as they should be displayed on the ServiceMaxx™ software screen.

1. Engine speed (below 700 RPM)
2. Vehicle not moving
3. Accelerator Pedal Position (APP) (0%)
4. Brake pedal released
5. Clutch pedal released



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Figure 938 DSI System Deaeration Procedure

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Key ON. Log in to ServiceMaxx™ software.

Test Procedure



Figure 939 Menu – Select Procedure

1. Select KOER Aftertreatment (AFT) Procedures > Down Stream Injection (DSI) System Deaeration (Figure 939) from the Procedures drop-down menu.
2. The procedure will cycle the Aftertreatment Fuel Enable CTL (AFT: FEC) and Aftertreatment Fuel Pressure CTL (AFT:FPC) to purge air from the system.

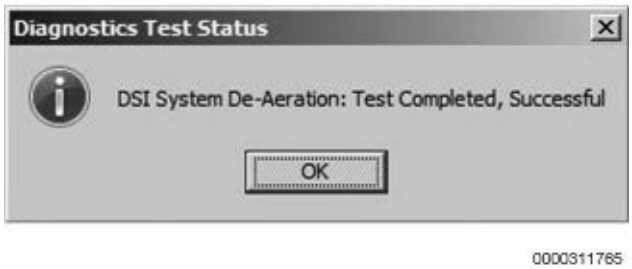


Figure 940 Test Complete

3. This procedure does not display pass or fail results and will display Test Completed, Successful (Figure 940) when finished.

Expected Outcome

Key-On Engine-Running (KOER) test will complete without any problems occurring.

Follow-On Procedure

None

KOER Aftertreatment DPF Regeneration Procedure

Overview

The Key On Engine Running (KOER) Aftertreatment Diesel Particulate Filter (DPF) Regeneration Procedure is used to clean Diesel Particulate Filter (DPF). Session is helpful to monitor all components in aftertreatment system.

WARNING: Set parking brake and gear before diagnostic or service test: To prevent personal injury or death, make sure parking brake is set, transmission is in neutral or park, and wheels are blocked before doing diagnostic or service procedures.

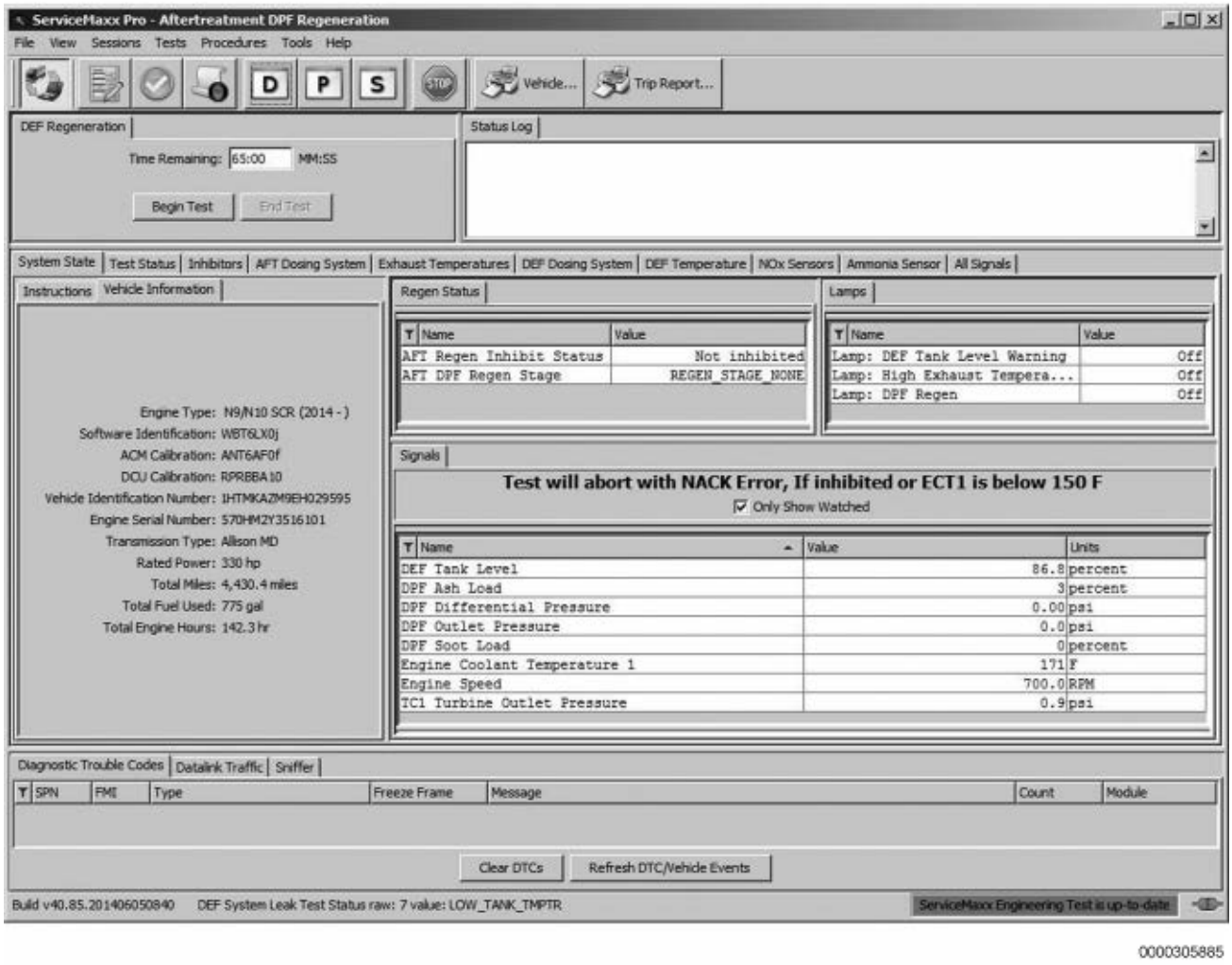
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- J1939-Compliant Interface Cable

Equipment Condition

1. Engine Speed (below 700 RPM).
2. Engine Coolant Temperature (above 150°F 66°C).
3. No Inhibitors (Figure 943).

Test Setup



0000305885

Figure 941 Aftertreatment DPF Regeneration Procedure

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

Test Procedure



Figure 942 Select Procedure

1. Start and warm engine coolant temperature above 150°F / 66°C.
2. Select KOER Aftertreatment Procedure – DPF Regeneration (Figure 942) from Procedures drop down menu.

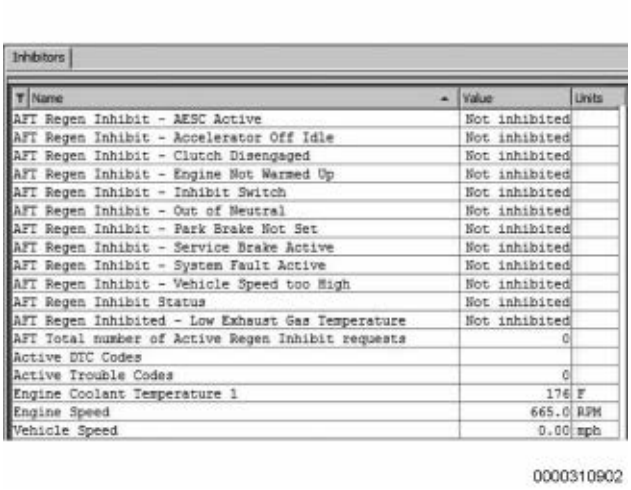


Figure 943 Menu – Inhibitors

3. Verify DPF Regeneration entry conditions are met and procedure is not inhibited (Figure 943).

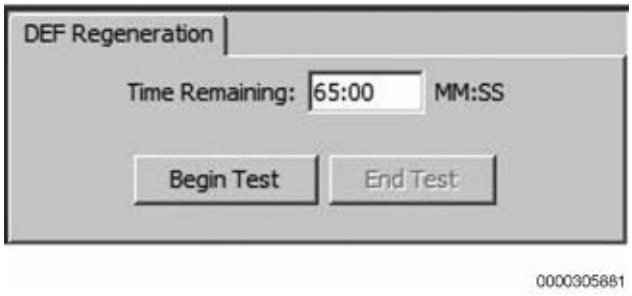


Figure 944 Begin Test

4. Press Begin Test button (Figure 944).
5. Engine Speed will ramp up to increase exhaust flow through the DPF. Procedure will run for 60 minutes and will display any pass or fail results.

Expected Outcome

None

Follow-On Procedure

None

Connect Cylinder Performance Analyzer (CPA) Tool

Overview

The Cylinder Performance Analyzer (CPA) Tool is a four-channel oscilloscope that is used to detect faults in various components. When used with the proper software, the CPA tool helps technicians diagnose engine systems by monitoring electrical signals from various engine-mounted sensors.

WARNING: To prevent personal injury or death, never allow the metal sensor tee harness connectors (BNC Connector) or the Cylinder Performance Analyzer (CPA) tool ports to contact metal, other sensor tee harness connectors, or ground.

CAUTION: To prevent damage, do not store the CPA tool in the engine compartment. Any exterior damage may adversely affect the functionality of the tool and cause flawed test results.

CAUTION: Secure the Cylinder Performance Analyzer (CPA) tool and test cables away from hot or moving parts and any source of radio frequency interference with cable ties while performing tests. Failure to comply could result in damage to equipment.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender to properly connect and safely route test cables into cab.

Test Setup

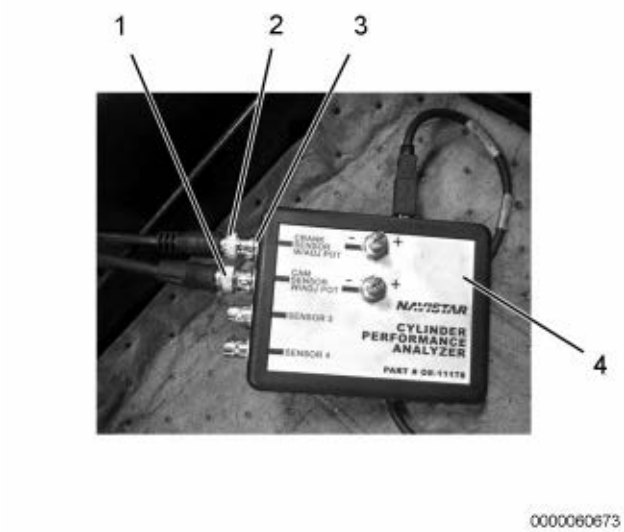


Figure 945 Cylinder Performance Analyzer (CPA) Tool

1. Camshaft Position (CMP) Sensor Tee Harness BNC connector
2. Crankshaft Position (CKP) Sensor Tee Harness BNC connector
3. CPA BNC connector
4. CPA tool (Most current version does not have adjusting knobs)

1. Connect Electronic Service Tool (EST) to vehicle diagnostic connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).

Test Procedure

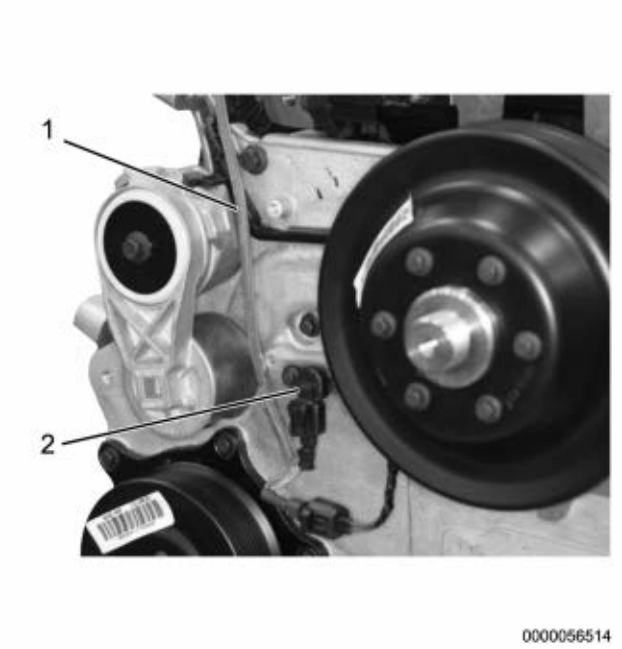


Figure 946 Camshaft Position Sensor 1

1. Camshaft position (CMP) sensor tee harness
2. CMP sensor

1. Connect Yellow Tee Harness 12-999-01-02 between Camshaft Position (CMP) (Figure 946) (Item 1) and engine harness, making sure to tie it back from hot or moving parts.
2. Securely connect metal end to connector on Cylinder Performance Analyzer (CPA) tool labeled Cam Sensor.

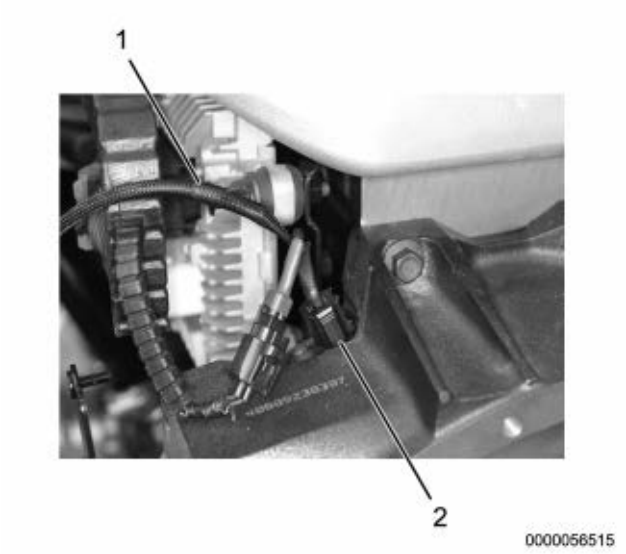


Figure 947 Crankshaft Position Sensor

1. Crankshaft position (CKP) sensor tee harness
2. CKP sensor

3. Connect Black Tee Harness 12-999-01-03 between Crankshaft Position (CKP) (Figure 947) (Item 1) and engine harness, making sure to tie it back from hot or moving parts.
4. Securely connect metal end to connector on CPA Tool labeled Crank Sensor.
5. Connect USB cable from CPA Tool to Electronic Service Tool (EST) with ServiceMaxx™ software.
   - Ensure light on CPA Tool (Figure 945) is flashing.
6. If doing CPA High Pressure Oil Pump (HPOP) Test, connect HPOP Test Harness 12–999–01–04 between engine harness and CPA Tool.
7. Recheck your test cable connections and routing to ensure they do not come in contact with hot or moving parts or unnecessary radio frequency interference.

Expected Outcome

Cylinder Performance Analyzer (CPA) tool test harnesses will be properly connected to perform standard tests.

Follow-on Procedure

Perform CPA Tool tests.

Cylinder Performance Analyzer (CPA) Cold Idle Test

Overview

Cylinder Performance Analyzer (CPA) Cold Idle Test detects faults with cylinder combustion during idle speed, and is usually performed if customer complaint includes a misfire during cold idle. When required, the Cold Idle Test should be performed prior to the Signal Check.

Tools Required

- Electronic Service Tool with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender to properly connect and safely route test cables into cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).
3. Connect Cylinder Performance Analyzer (CPA) (page 2197) tool.

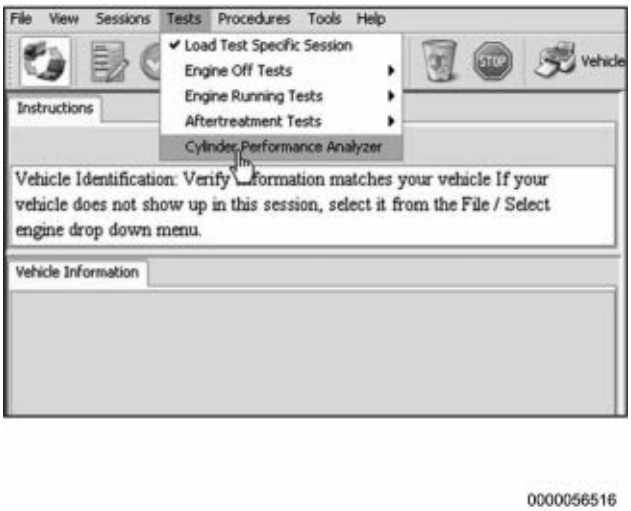


Figure 948 ServiceMaxx™ Menu

4. Start CPA software in ServiceMaxx™ by selecting Tests > Cylinder Performance Analyzer (Figure 948).



Figure 949 Information Text Fields

5. Fill in Dealer location, operator / technician Information and Customer Complaint text fields (Figure 949).
6. Verify Vehicle Data matches the information in text fields (Figure 949).

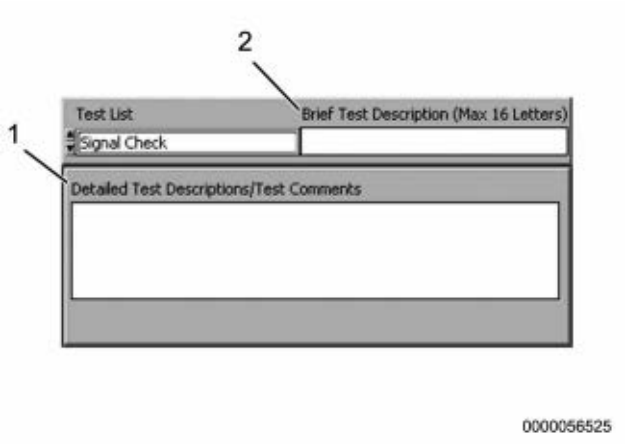


Figure 950 Test Description Text Fields

1. Detailed Test Description / Test Comments Field
2. Brief Test Description Text Field

7. Enter information into Brief Test Description (item 2) and Detailed Test Description / Test Comments (item 1) text fields (Figure 950).

Test Procedure

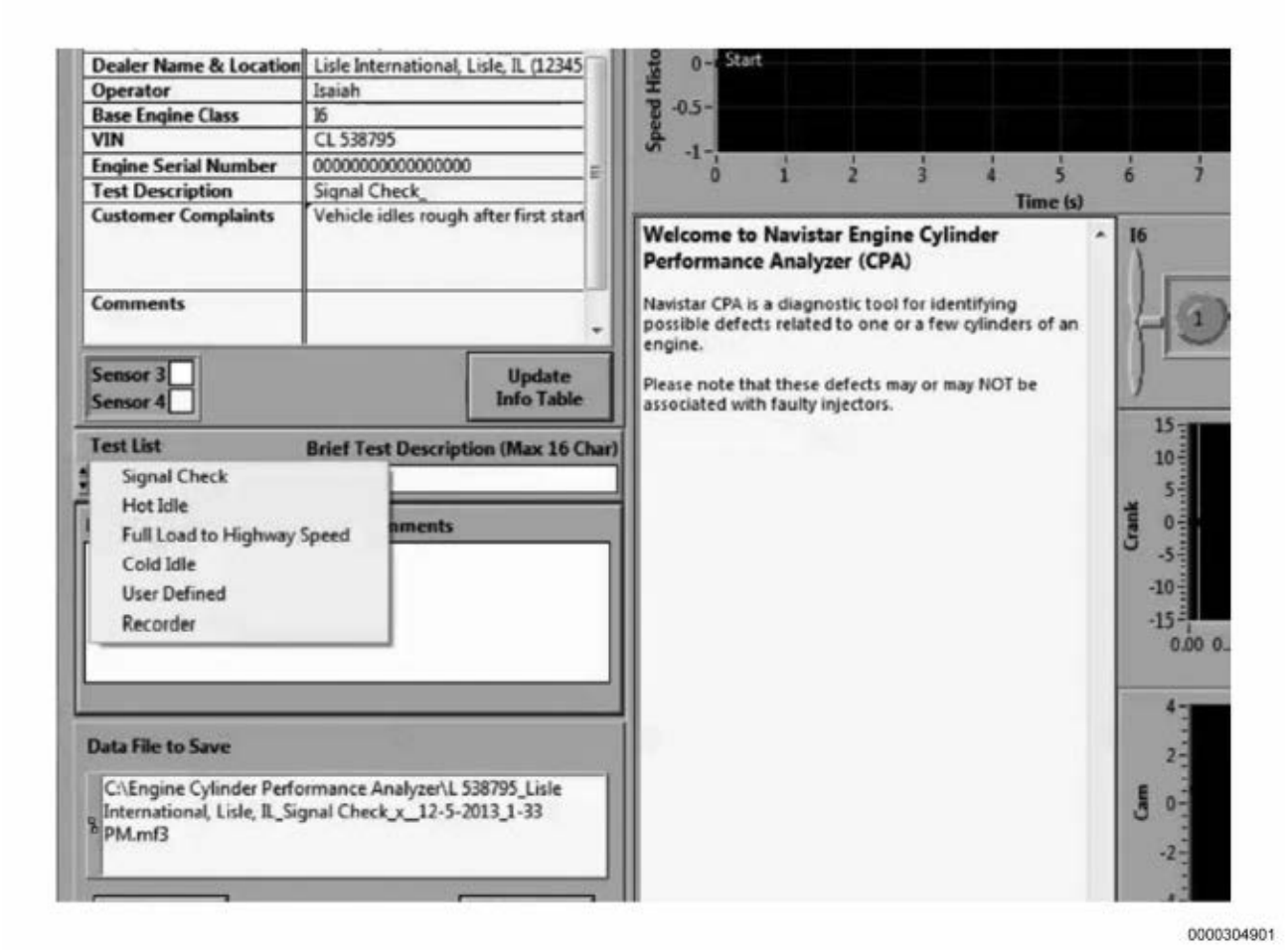


Figure 951 Test List

1. Select Cold Idle from Test List (Figure 951).
2. Start engine.

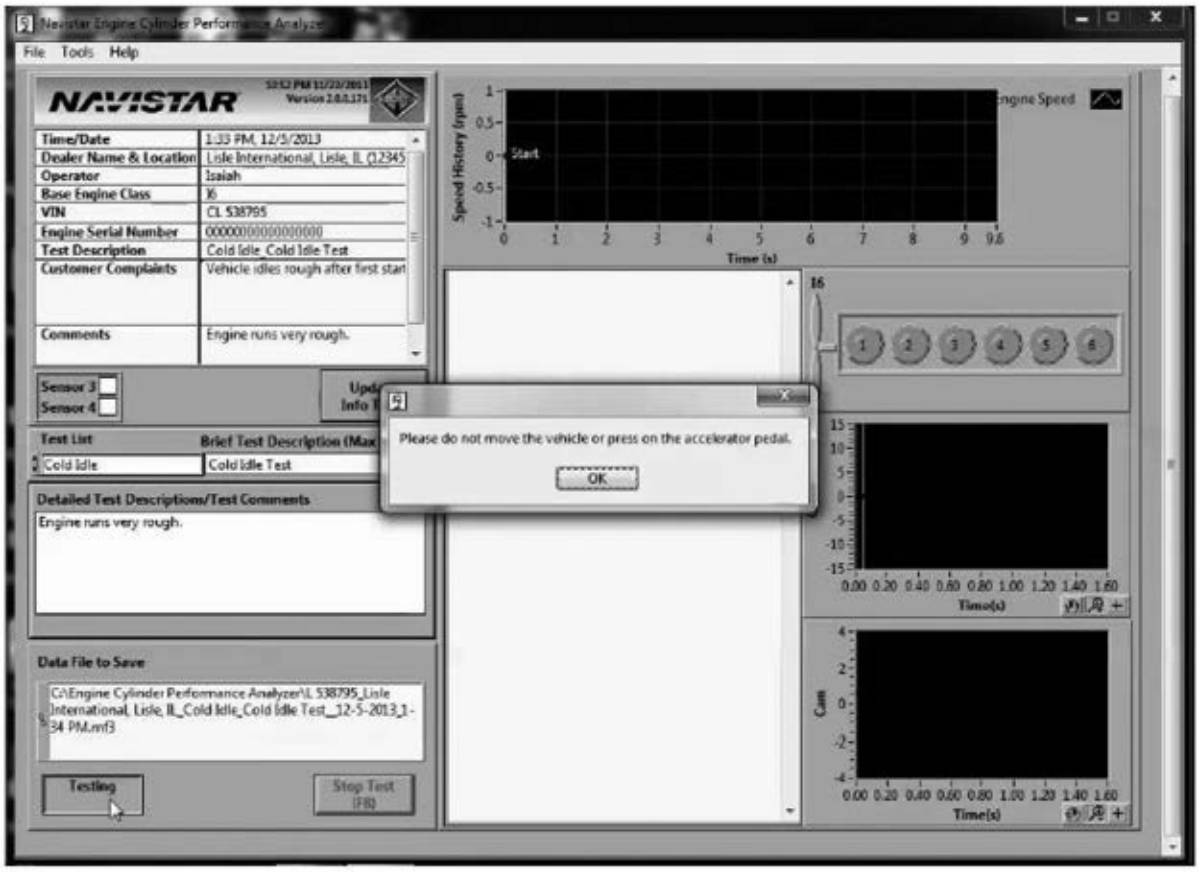


Figure 952 Start Test Window

3. Click button on bottom left corner to Start Test (Figure 952).
4. Follow on screen instructions to complete test.
5. When End of Test text field appears, enter any final details about the test.
6. Click Return button to return to Home screen and view test results.

Expected Outcome

Test will run successfully, return to step based diagnostics with test information, or continue Cylinder Performance Analyzer (CPA) diagnostics as needed. Green cylinders indicate no defects were found; a red cylinder indicates a problem with that cylinder (may or may not be an injector); and light blue cylinders indicates high engine speed fluctuations, but no problem with a particular cylinder.

Follow-on Procedure

None

Cylinder Performance Analyzer (CPA) Signal Check

Overview

Signal check ensures information from Crankshaft Position (CKP) Sensor and Camshaft Position (CMP) sensor are being read properly by the Cylinder Performance Analyzer (CPA) program and are not distorted. Signal check must be performed before the full load to highway speed test, or any other test involving the vehicle being driven. CPA software will only recognize, for a limited time, that Signal Check has been completed before it resets and inhibits any test involving the vehicle being driven.

Tools Required

- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender in order to properly connect and safely route test cables into cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).
3. Connect Cylinder Performance Analyzer (CPA) Tool Kit (Connect Cylinder Performance Analyzer (CPA) Tool, page 2197).

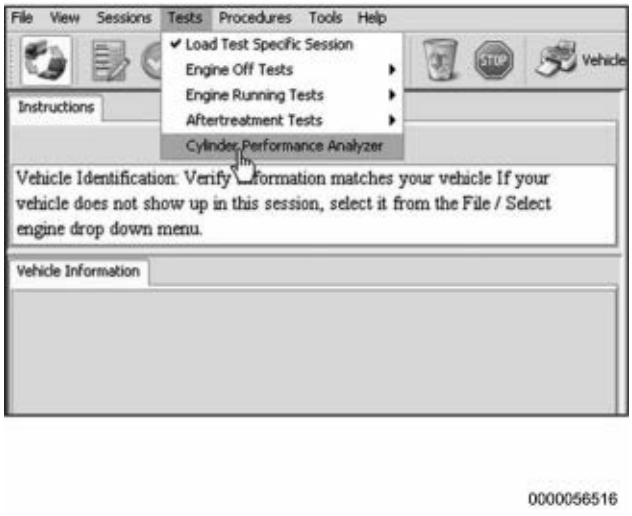


Figure 953 ServiceMaxx™ Software Menu for CPA

4. Start CPA software in ServiceMaxx™ by selecting Tests > Cylinder Performance Analyzer (Figure 953).



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Figure 954 Information Text Fields

5. Fill in dealer location, operator/technician information and customer complaint text fields (Figure 954).
6. Verify vehicle data matches information in text fields (Figure 954).

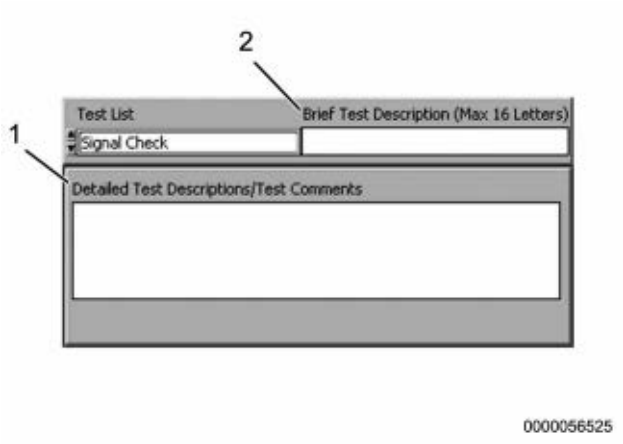


Figure 955 Test Description Text Fields

1. Detailed Test Description/Test Comments text Field
2. Brief Test Description text Field

7. Enter information into brief test description (item 2) and detailed test description/test comments (item 1) text fields (Figure 955).

Test Procedure

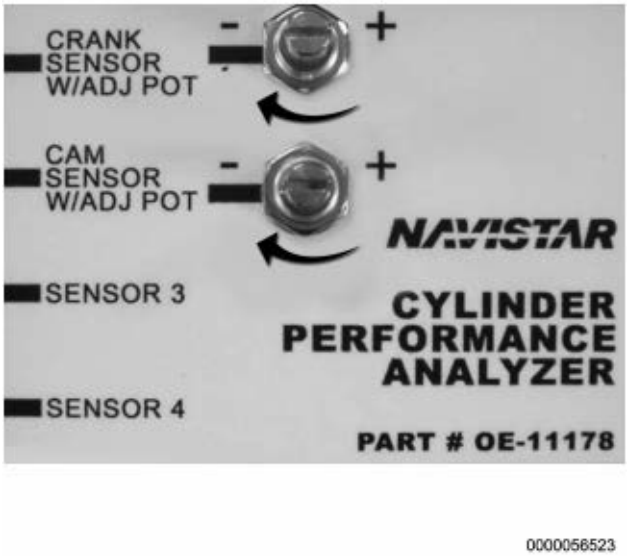


Figure 956 Cylinder Performance Analyzer

Later generations of the CPA tool do not have adjusting knobs. If using a tool with adjusting knobs, proper calibration is rotated fully to the right (clockwise) (Figure 956).

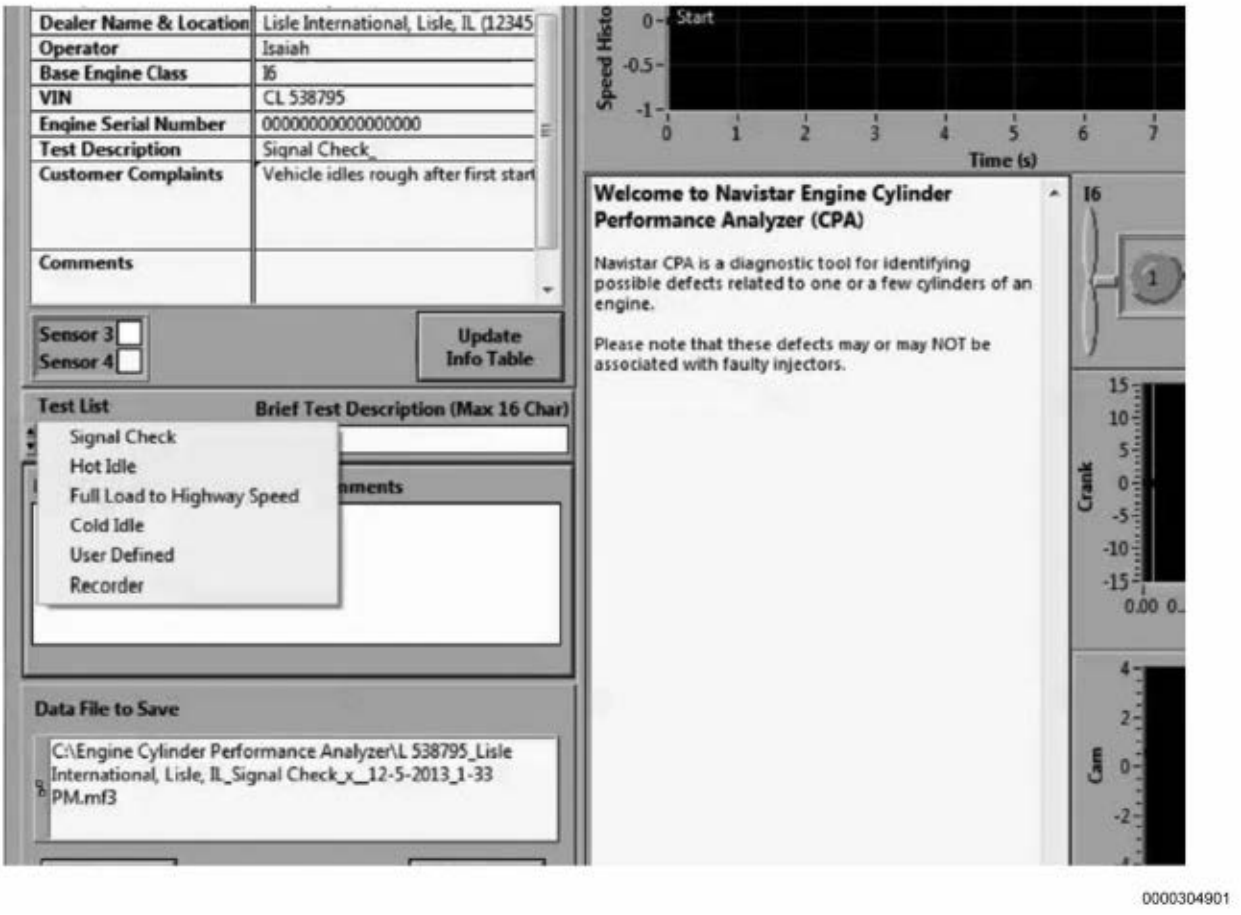


Figure 957 Test List

1. Select Signal Check from Test List (Figure 957).
2. Start engine.

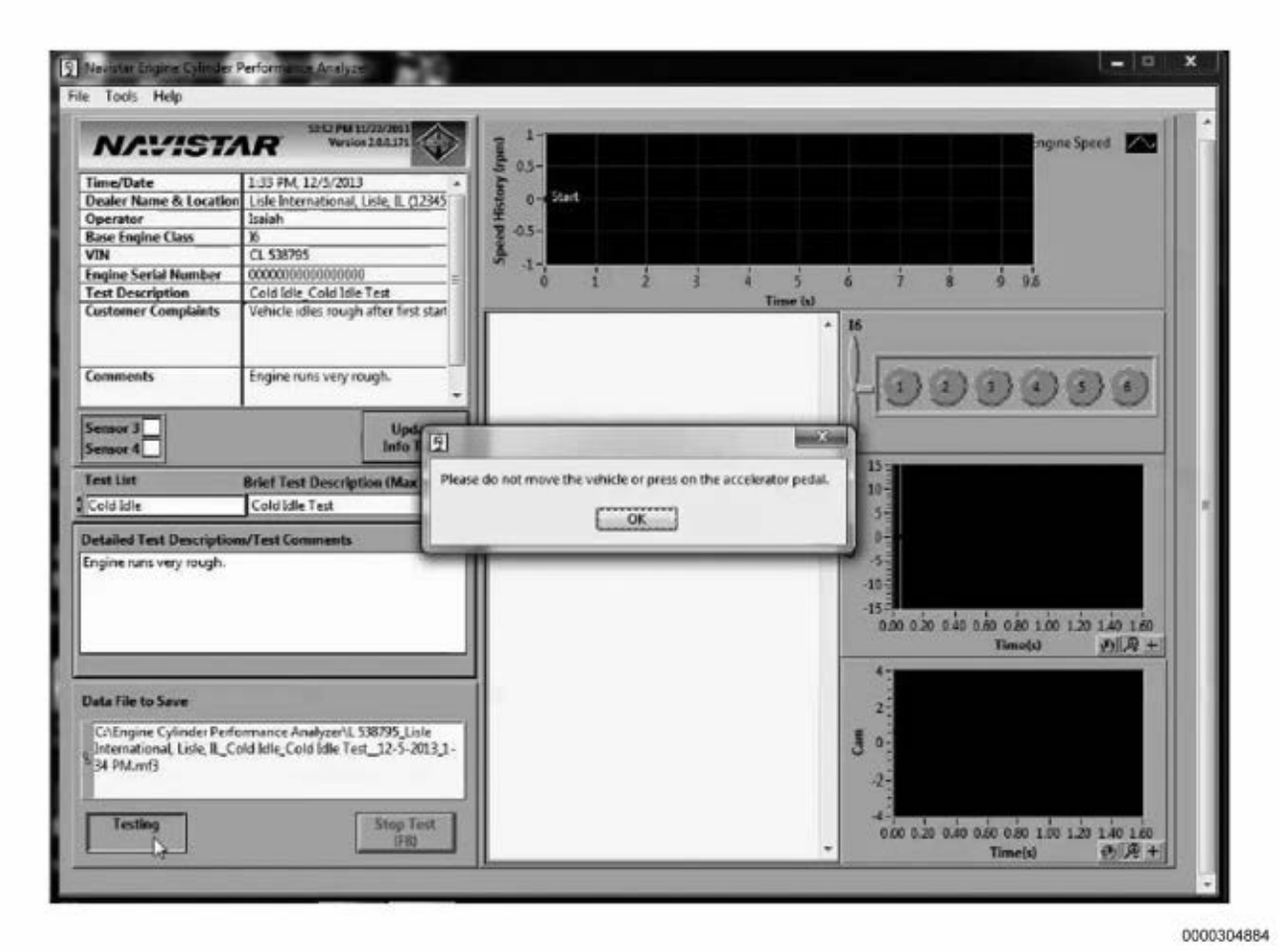


Figure 958 Start Test Window

3. Click button on bottom left corner to start test (Figure 958).

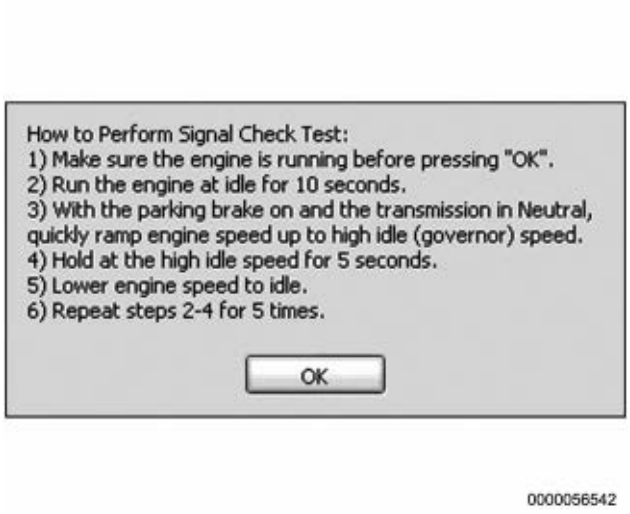


Figure 959 Signal Test Instructions

4. Follow on-screen instructions to complete test. (Figure 959)
5. When End of Test text field appears, enter any final details about the test.
6. Click Return button to return to home screen and view test results.

Expected Outcome

Test will run successfully, signal adjustment will be made, and any road test can be performed after test is run. Return to step based diagnostics or continue with Cylinder Performance Analyzer (CPA) diagnostics as needed.

Follow-On Procedure

None

Cylinder Performance Analyzer (CPA) Hot Idle Test

Overview

Hot-idle test detects faults with cylinder combustion during idle speed with engine at or above operating temperature, and is usually performed if customer complaint includes a misfire during hot idle. Signal check should be performed before hot-idle test.

Tools Required

- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fender and / or passenger side inner fender in order to properly connect and safely route test cables into cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).
3. Connect Cylinder Performance Analyzer (CPA) Tool 12-999-01 (page 2197).

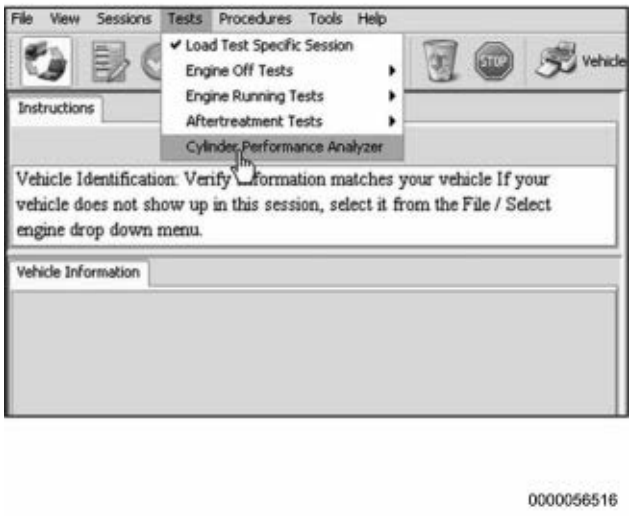


Figure 960 ServiceMaxx™ Menu

4. Start CPA software in ServiceMaxx™ by selecting Tests > Cylinder Performance Analyzer (Figure 960).



Figure 961 Information Text Fields

5. Input dealer location, operator / technician and customer complaints in appropriate text fields (Figure 961).
6. Verify Vehicle Data (Figure 961) matches information in text fields.

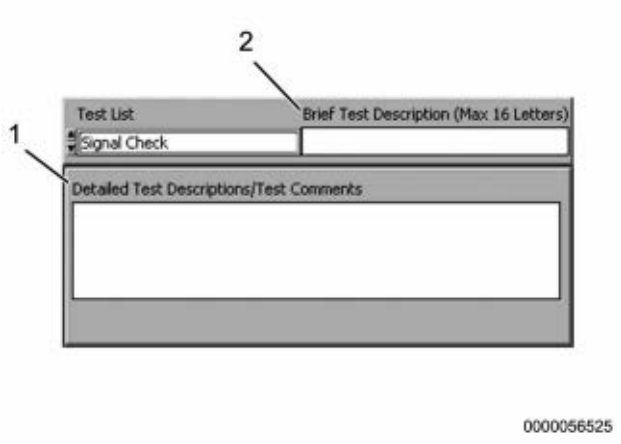


Figure 962 Test Description Text Fields

1. Detailed Test Description / Test Comments field
2. Brief Test Description field

7. Enter information into Brief Test Description (item 2) and Detailed Test Description / Test Comments (item 1) text fields that describe what and why you are testing (Figure 962).
8. Ensure engine coolant temperature is above 180°F (82°C), if not, run engine to reach operating temperature.
9. If necessary, perform CPA Signal Check (page 2206).

Test Procedure

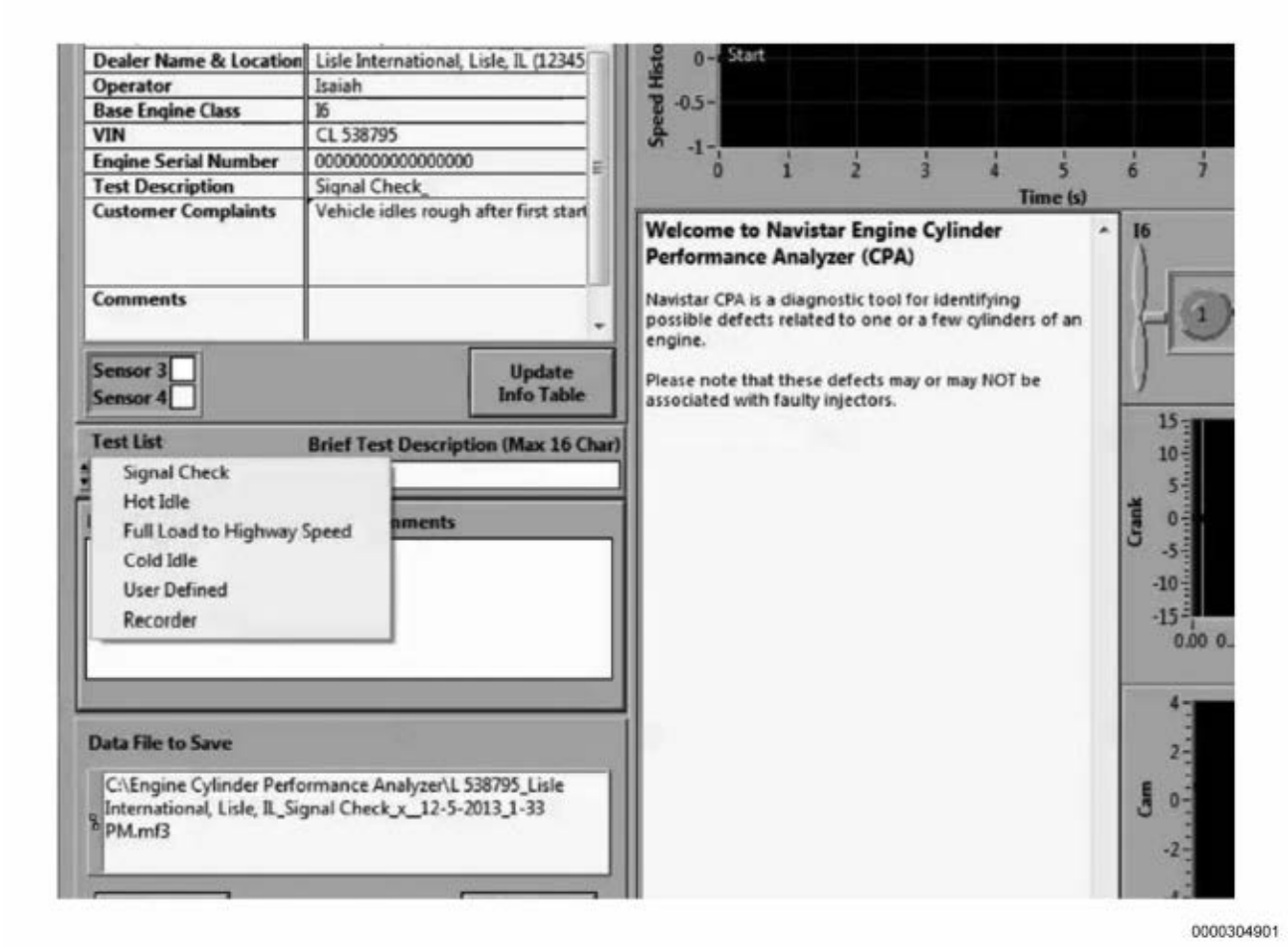


Figure 963 Test List

1. Select Hot Idle from Test List (Figure 963).
2. If engine is not running, Start engine.

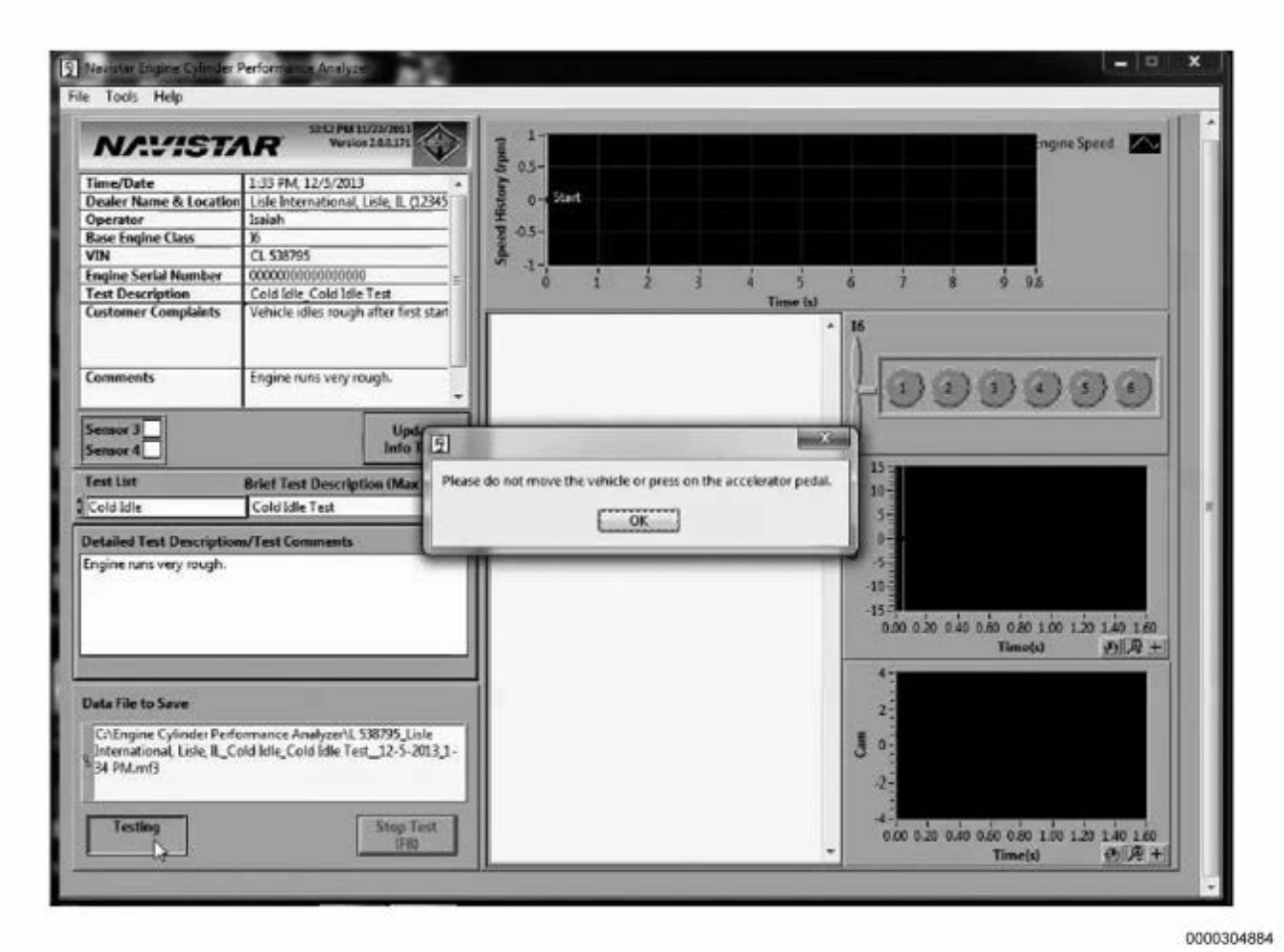


Figure 964 Start Test Window

3. Click button on bottom left corner to start test (Figure 964).
4. Follow on-screen instructions to complete this test.
5. When End of Test text field appears, enter any final details about test.
6. Click Return button to go back to home screen and view test results.

Expected Outcome

Test will run successfully. Return to step based diagnostics with test information or continue Cylinder Performance Analyzer (CPA) diagnostics as needed. Green cylinders indicate no defects were found; a red cylinder indicates a problem with that cylinder (may or may not be an injector); and light blue cylinders indicates high engine speed fluctuations, but no problem with a particular cylinder.

Follow-On Procedure

None

Cylinder Performance Analyzer (CPA) Road Test

Overview

The Full Load to Highway Speed Test is used to detect faults with cylinder combustion during acceleration, under a load and involves the vehicle being driven. The signal check must be performed prior to attempting this test. Testing will stop automatically once vehicle reaches highway speed and/or all necessary data has been collected. The Cylinder Performance Analyzer (CPA) software will only recognize for a limited time that signal check has been completed before it will reset and inhibit any test that involves vehicle being driven.

WARNING: To prevent personal injury or death, do not exceed local speed limits, disobey traffic laws or drive too fast for conditions while performing this test.

Tools Required

- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01
- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

Depending on the truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender in order to properly connect and safely route test cables into cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).
3. Connect Cylinder Performance Analyzer (CPA) Tool Kit (page 2197) 12-999-01.

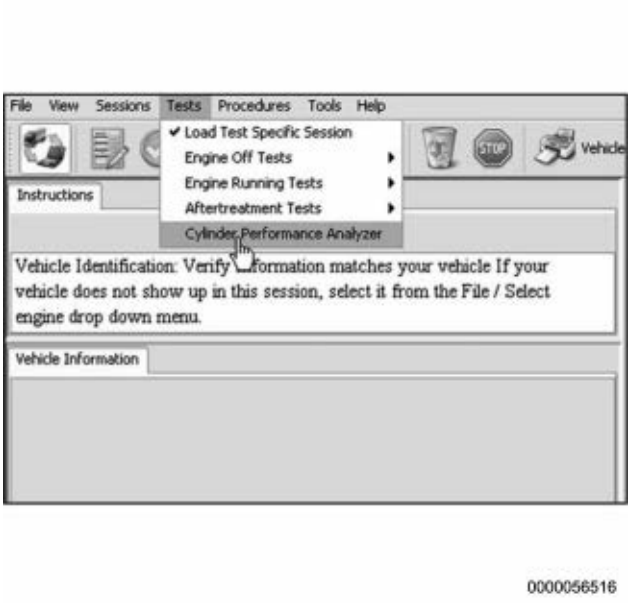


Figure 966 ServiceMaxx™ Menu

4. Start CPA software in ServiceMaxx™ by selecting Tests > Cylinder Performance Analyzer (Figure 966).



Figure 967 Information Text Fields

5. Fill in dealer location, operator/technician information and customer complaint in text fields (Figure 967).
6. Verify vehicle data matches information in text fields (Figure 967).

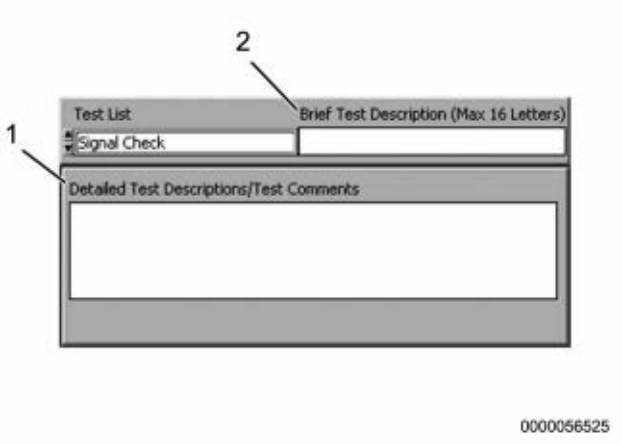


Figure 968 Test List

1. Detailed Test Description / Test Comments field
2. Brief Test Description field

7. Enter information into brief test description (item 2) and detailed test description/test comments (item 1) text fields (Figure 968).
8. If necessary, perform CPA Signal Check (Cylinder Performance Analyzer (CPA) Signal Check, page 2206).

Test Procedure

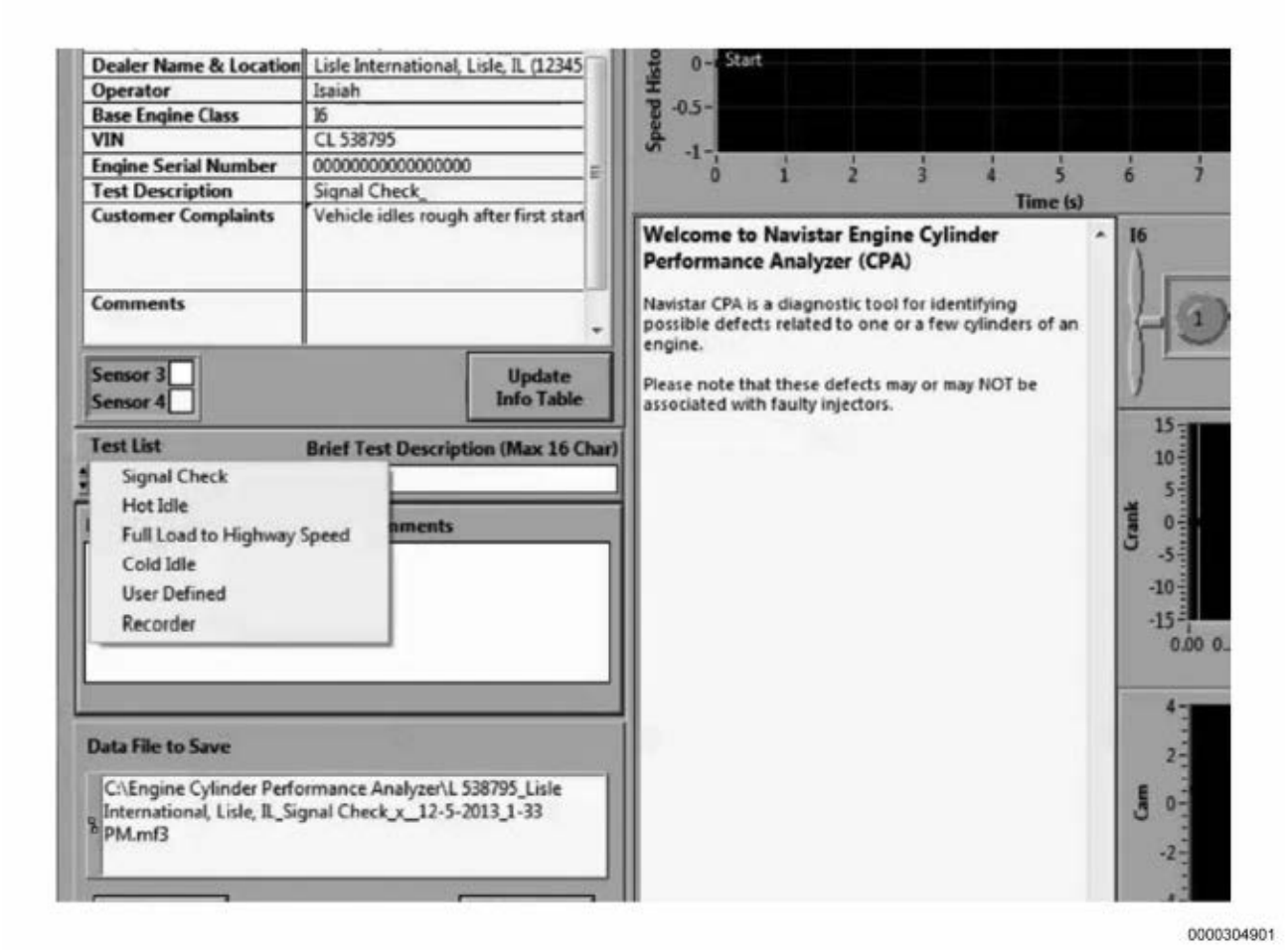


Figure 969 Test List

1. Select Full Load to Highway Speed test from Test List (Figure 969).
2. Start engine.

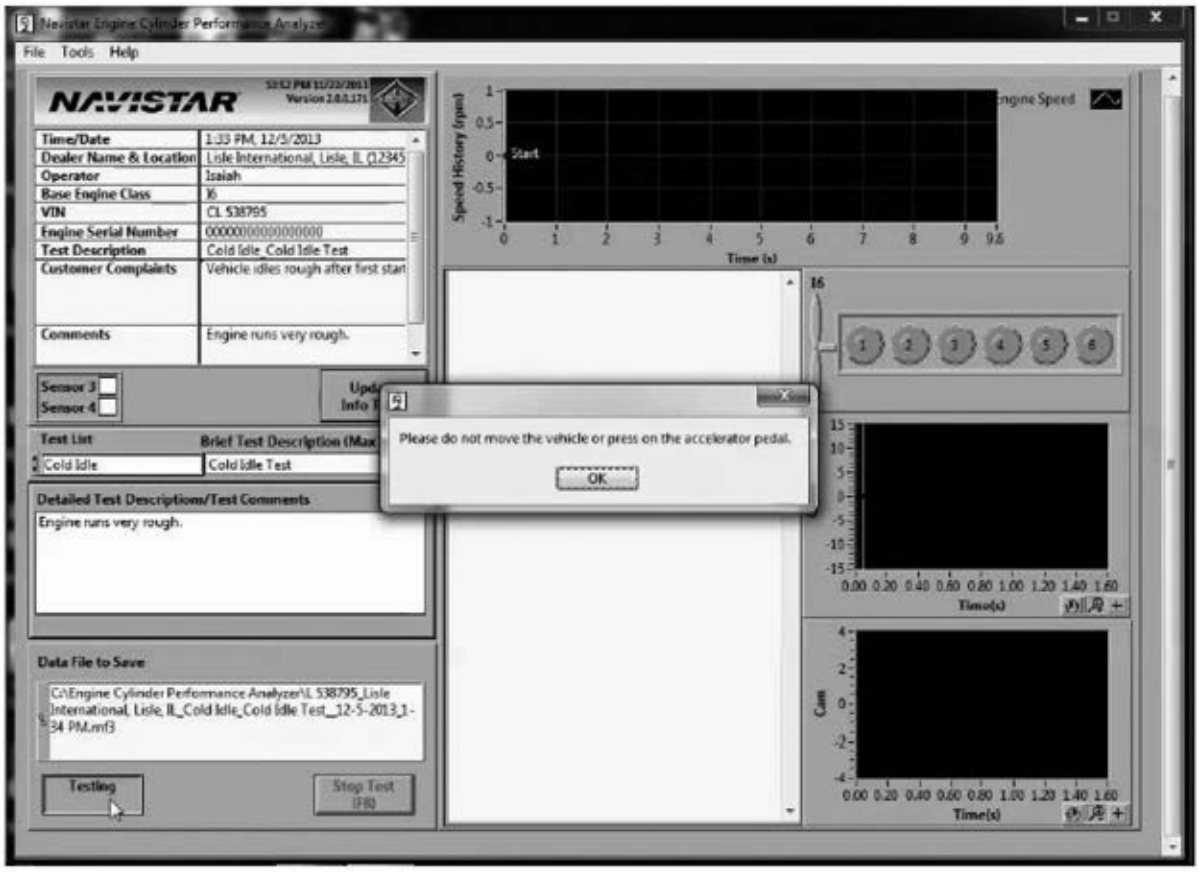


Figure 970 Start Test Window

3. Click button on the bottom left corner to start test (Figure 970).
4. Follow on-screen instructions to complete test.
5. When End of Test text field appears, enter any final details about test.
6. Click Return button to return to home screen and view test results.

Expected Outcome

Test will complete successfully and will automatically stop when necessary data has been recorded. Review test results and return to step-based diagnostics or continue with Cylinder Performance Analyzer (CPA) testing as needed.

Follow-On Procedure

None

Cylinder Performance Analyzer (CPA) Advanced Testing

Overview

Cylinder Performance Analyzer (CPA) advanced testing can be used with or without the guidance of Navistar® Technical Services. This allows the user to test other sensor signals to perform a wider variety of diagnostics. Technician can not view data taken on sensor ports 3 and 4 without contacting tech central support.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Cylinder Performance Analyzer (CPA) Tool Kit 12-999-01

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender to properly connect and safely route test cables into the cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log in to ServiceMaxx™ software (page 2096).
3. Connect Cylinder Performance Analyzer (CPA) (page 2197) tool.
4. Connect Extension Harness 12-999-01-05 and 2-Pin Banana Plug 12-999-01-06 to sensor(s) you wish to monitor and to CPA tool, ensuring to route them away from hot or moving parts.

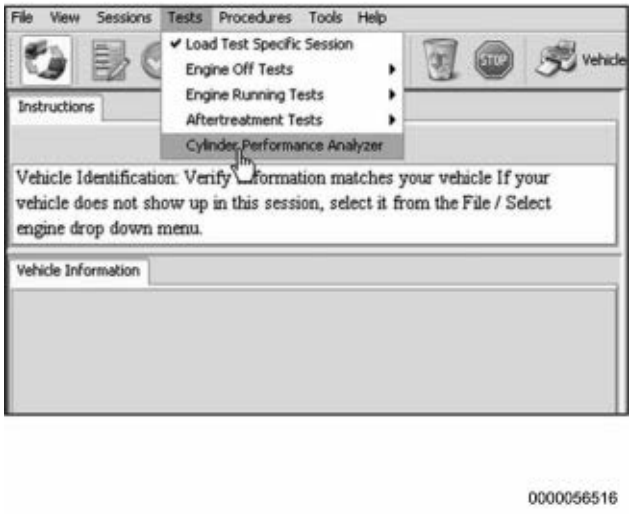


Figure 971 ServiceMaxx™ Menu

5. Start CPA software in ServiceMaxx™ by selecting Tests > Cylinder Performance Analyzer (Figure 971).



Figure 972 Information Text Fields

6. Fill in dealer location, operator / technician information and customer complaint text fields (Figure 972).
7. Verify vehicle data matches information in text fields (Figure 972).

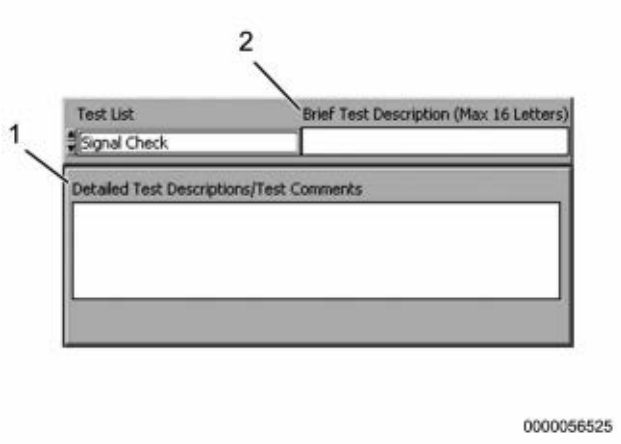


Figure 973 Test Description Text Fields

1. Detailed Test Description / Test Comments field
2. Brief Test Description field

8. Enter information into Brief Test Description (item 2) and Detailed Test Description / Test Comments (item 1) text fields (Figure 973).

Test Procedure

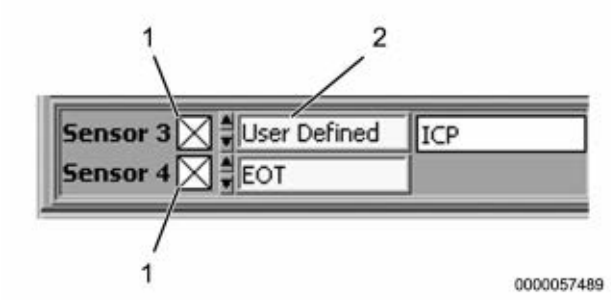


Figure 974 Sensor 3 and Sensor 4 data fields

1. Sensor 3 and 4 check box
2. Sensor connected

1. Add data for sensor(s) connected in the field for Sensor 3 and Sensor 4 (Figure 974), if needed.

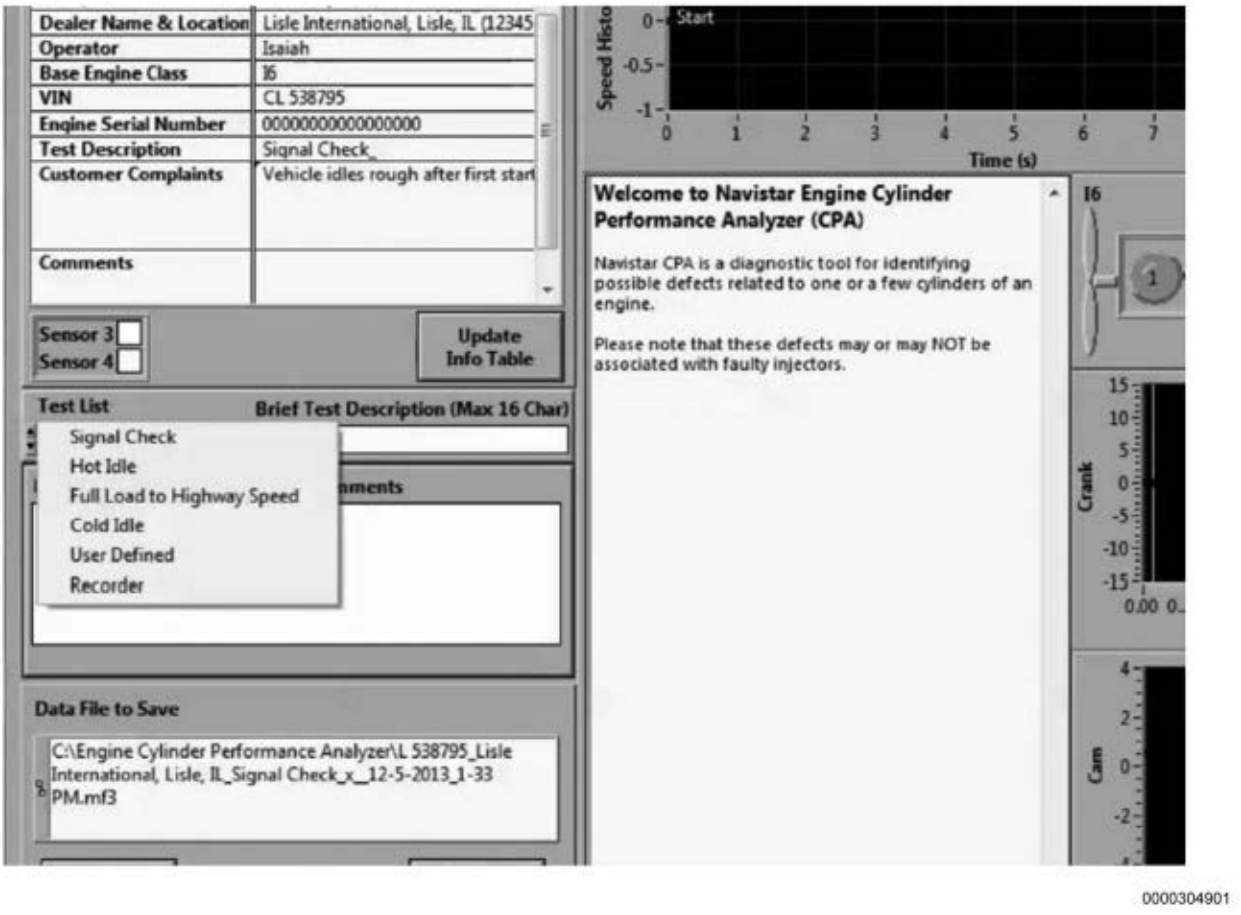


Figure 975 Test List

2. Select User Defined in the drop-down list of Tests (Figure 975).
3. Start Engine.

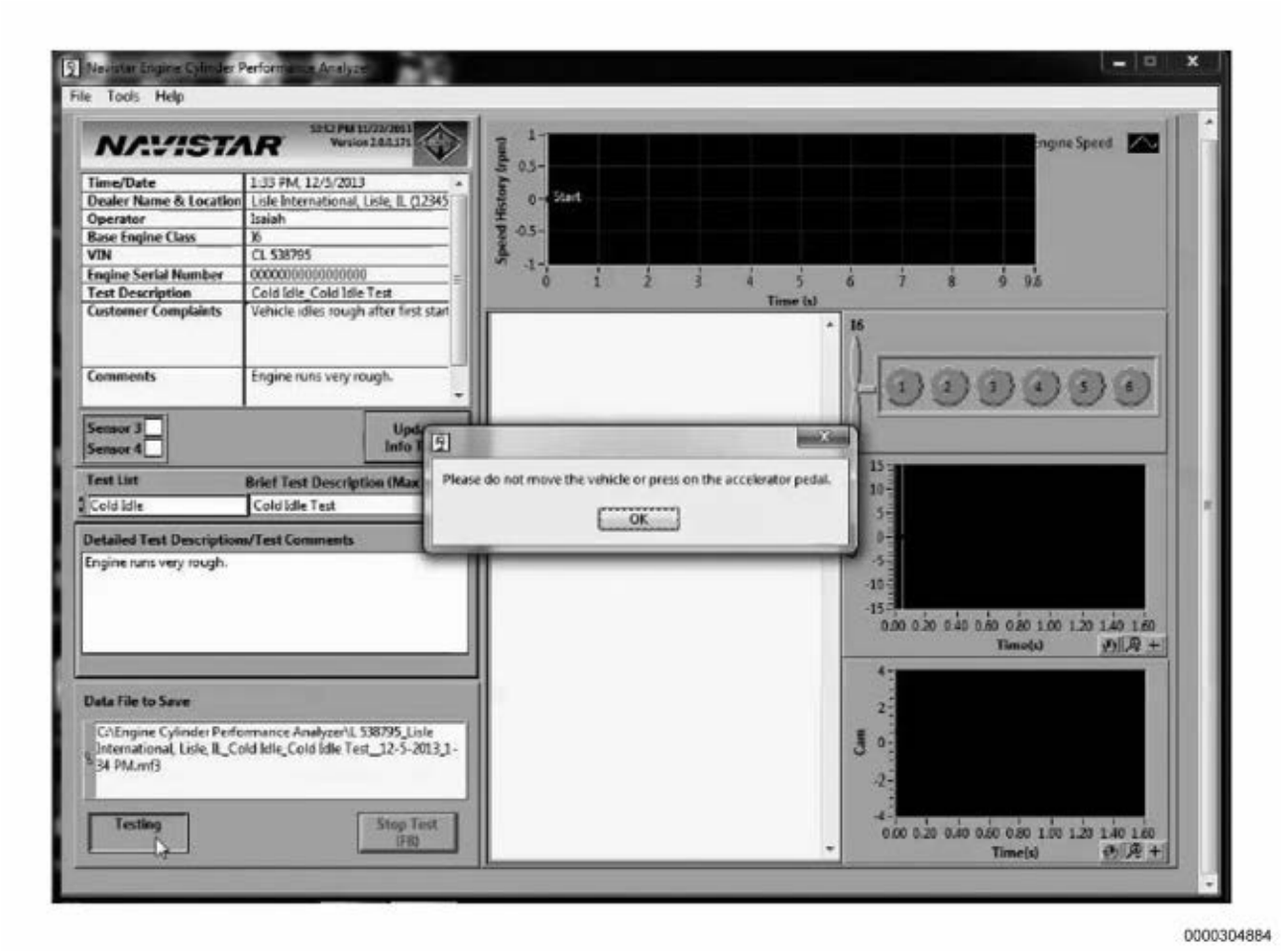


Figure 976 Start Test Window

4. Click button on bottom left corner to start test (Figure 976).
5. Follow on-screen instructions to complete this test.
6. When End of Test text field appears, you can enter any final details about the test.
7. Click Return button to return to Home screen and view test results.

Expected Outcome

Test will run successfully, return to step based diagnostics with test information, or continue Cylinder Performance Analyzer (CPA) diagnostics as needed. Green cylinders indicate no defects were found; a red cylinder indicates a problem with that cylinder (may or may not be an injector); and light blue cylinders indicates high engine speed fluctuations, but no problem with a particular cylinder.

Follow-on Procedure

None

Cylinder Performance Analyzer (CPA) – High-Pressure Oil Pump (HPOP) Test

Overview

Cylinder Performance Analyzer (CPA) – High-Pressure Oil Pump (HPOP) Test is a group of tests used to diagnose defects in the High-Pressure Oil System consisting of the Injection Pressure Regulator (IPR) Engine Control Module (ECM) Powered Test, IPR (Full Fielded) Test, IPR Removed and Plug Tool Installed Test, and Pump Deadheaded Test. It may not be necessary to perform all tests in the CPA HPOP Test. If software detects a fault in the High Pressure Oil System during any test, a Warranty Authorization Code (WAC) will be generated. Any other faults will be displayed in the Summary Text Box. If no fault is found, the software will recommend performing the next test in the series.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Cylinder Performance Analyzer (CPA) Tool Kit – 12-999-01

Equipment Condition

Depending on truck model, it may be necessary to remove operator's side inner fender, quarter fenders and/or passenger side inner fender to properly connect and safely route test cables into cab.

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Key ON. Log into ServiceMaxx™ software.
3. Connect Cylinder Performance Analyzer (CPA) Tool 12-999-01 (page 2197).

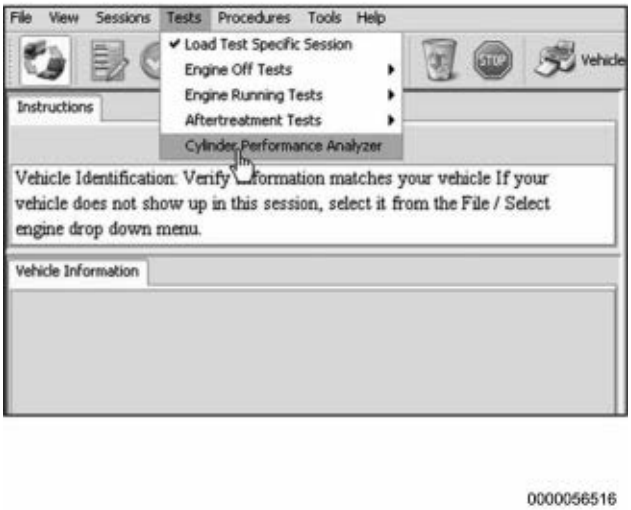


Figure 977 ServiceMaxx™ Menu

4. Start CPA software in ServiceMaxx™ software by selecting Tests > Cylinder Performance Analyzer (Figure 977).



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Figure 978 Information and Text Fields

5. Verify vehicle data matches information in text fields (Figure 978).
6. Fill in Dealer name and location, technician / operator information and customer complaints in the appropriate text fields (Figure 978).

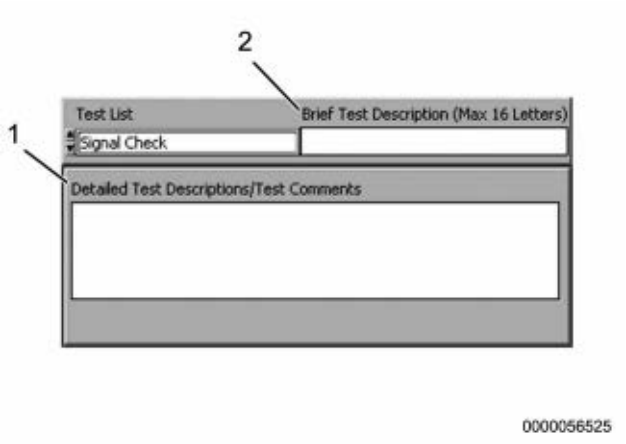


Figure 979 Brief and Detailed Test Description Fields

1. Detailed Test Description / Test Comment Field
2. Brief Test Description Text Field

7. Enter test details into the Brief Test Description (item 2) and Detailed Test Description / Test Comments (item 1) text fields (Figure 979).

Test Procedure

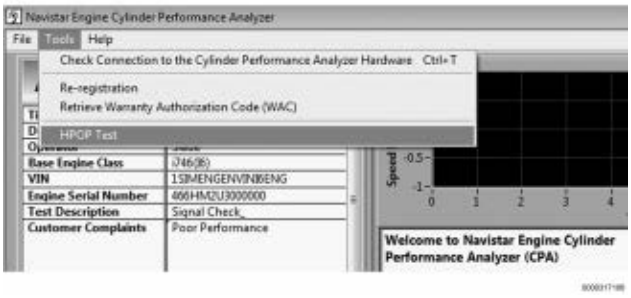


Figure 980 CPA Tools Menu

1. Select Tools > HPOP Tests (Figure 980).

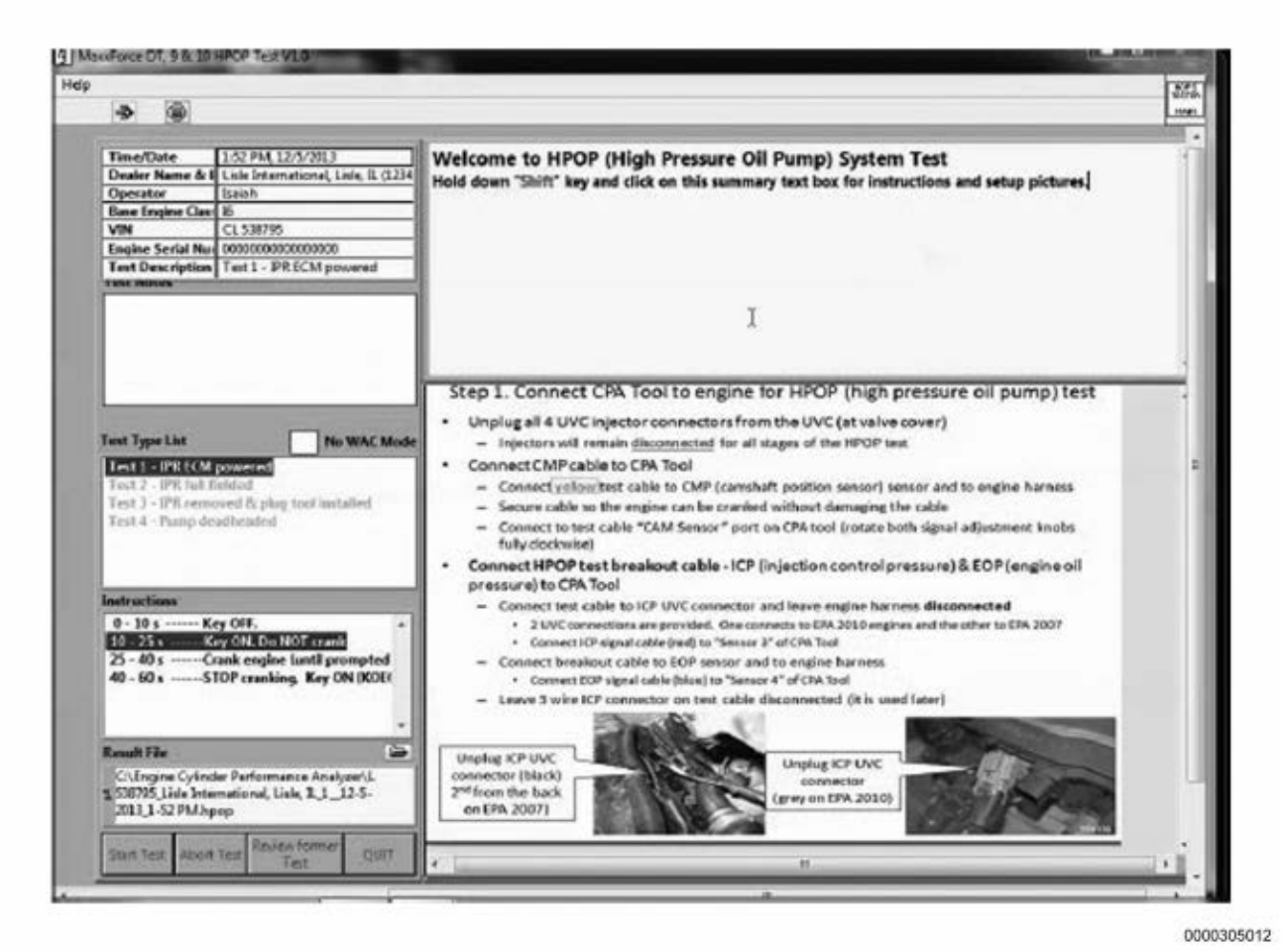


Figure 981 Instructions to Set-up and Perform Tests

2. Follow on-screen instructions (Figure 981) to prepare to run this group of tests.
3. Click the Start Test button on bottom left corner.
4. Follow on-screen instructions (Figure 981) to complete this test.
5. When End of Test text field appears, you can enter any final details about the test.
6. Click Return button to return to Home screen and view test results.
7. Perform next recommended test or make repairs as necessary

Expected Outcome

Tests will run successfully, identifying a failed component or sending the user to the next test in the sequence. When this series is complete, return to step-based diagnostics, or perform leak test according to Cylinder Performance Analyzer (CPA) findings.

Follow-on Procedure

None

Record Snapshot of Engine Running Data

Overview

Record engine running data to be referenced now and in the future. Recreate engine running problem during the test if possible.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Running (KOER).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log into ServiceMaxx™ software.

Test Procedure

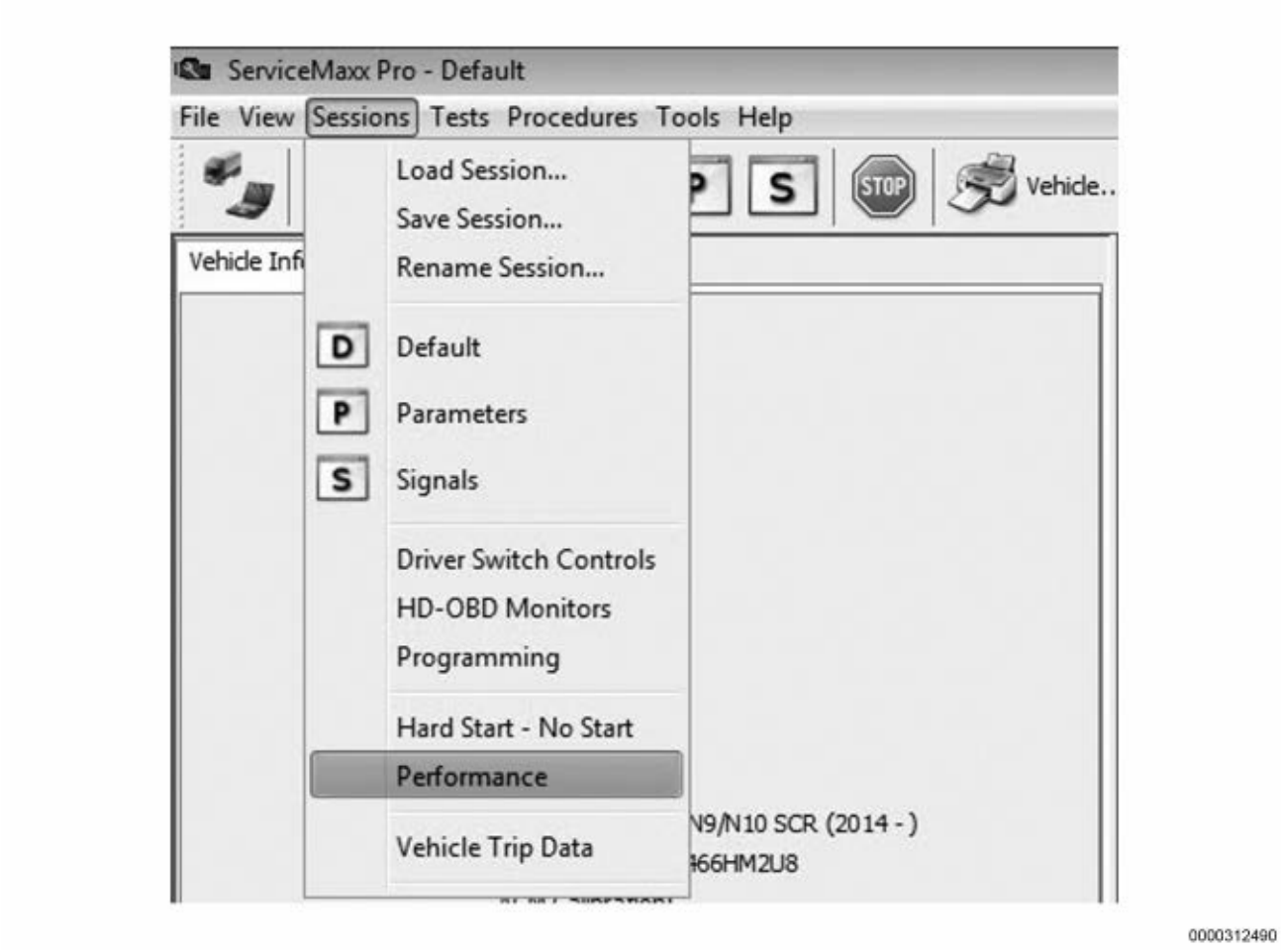


Figure 982 Sessions Menu

1. Select Sessions > Performance (Figure 982).

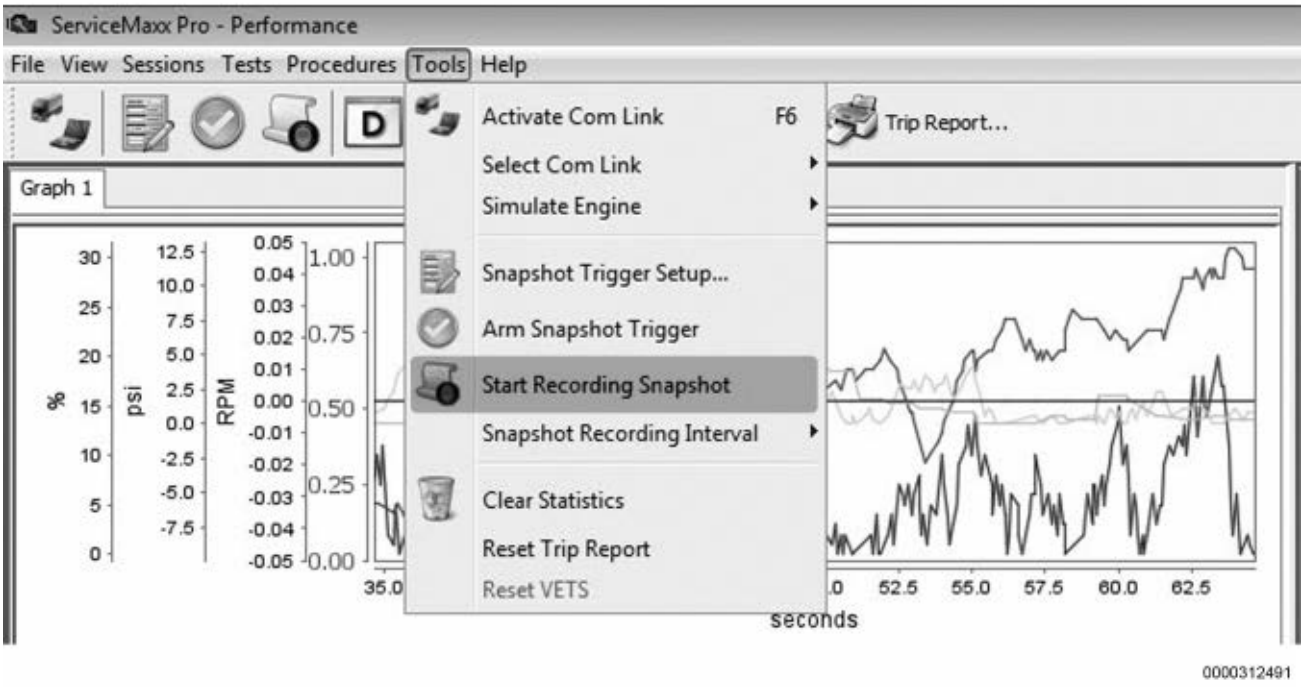


Figure 983 Start Recording

2. Select Tools > Start Recording Snapshot (Figure 983).
3. Recreate engine running problem.

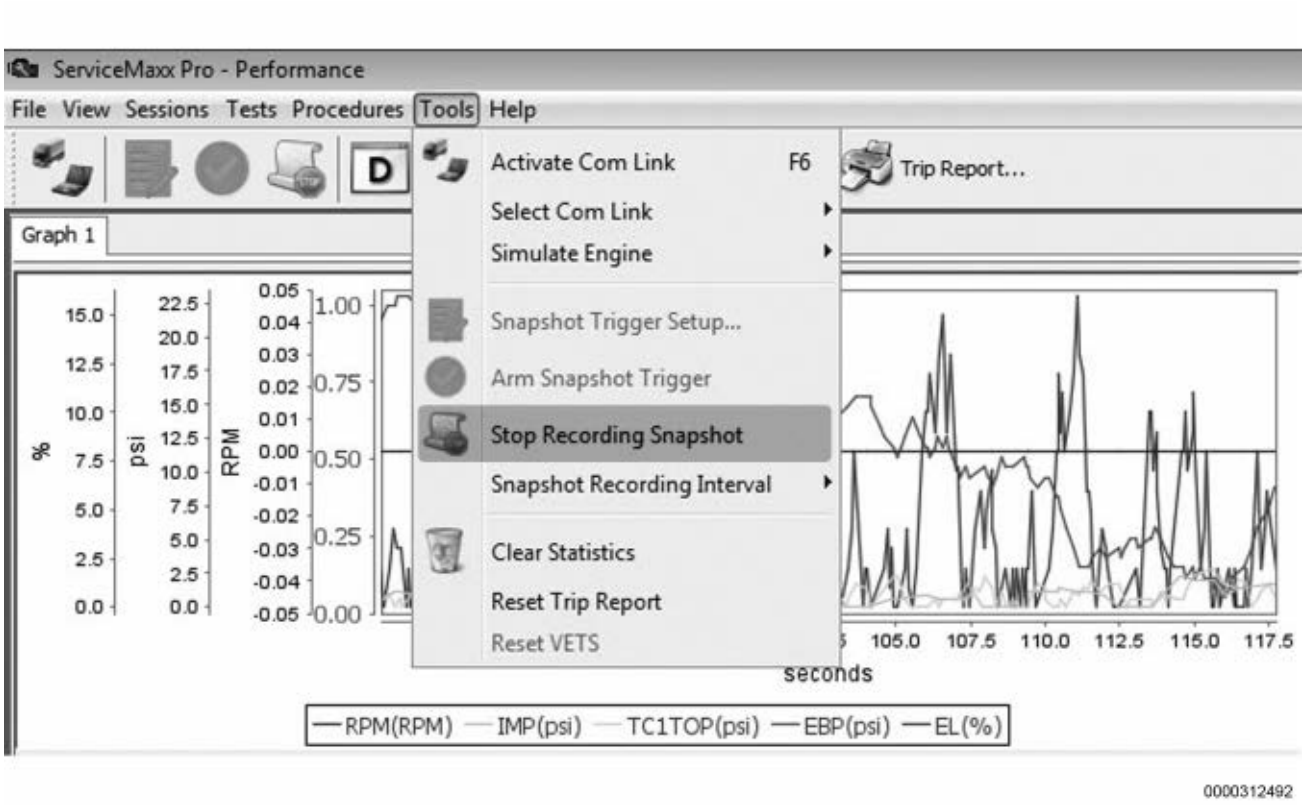


Figure 984 Stop Recording

4. Select Tools > Stop Recording Snapshot (Figure 984).

Expected Outcome

Engine running values will be within specification. Save Snapshot for reference later in diagnostic procedures.

Follow-On Procedure

None

Road Test

0 to 60 MPH Test

Overview

This test checks for unacceptable performance under a load at rated speed, and requires operation of vehicle. Using record feature in ServiceMaxx™ while driving on an open stretch of road trying to reproduce complaint, signals are recorded so they can be analyzed to determine which system is causing faults.

WARNING: To prevent personal injury or death, do not exceed local speed limit laws or drive too fast for conditions when performing 0 to 60 mph test.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Running (KOER).
2. Connect Electronic Service Tool (EST) to Vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.
4. Run engine until Engine Coolant Temperature (ECT) is above 158°F (70°C).

Test Procedure

1. Drive vehicle to a suitable and safe location to perform test.
2. Pull over to side of road.

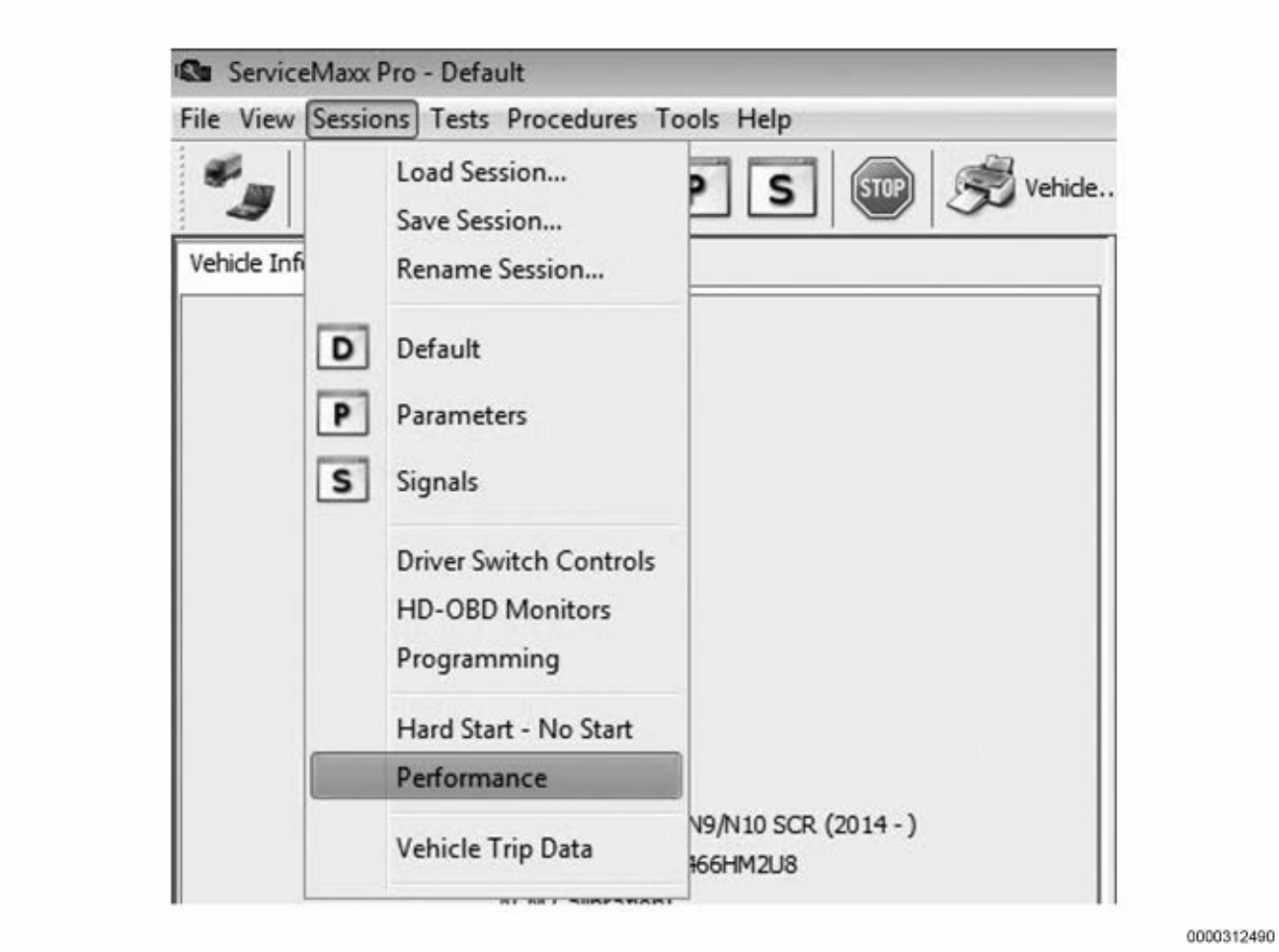


Figure 985 Menu – Select Performance

3. Select Sessions > Performance (Figure 985).

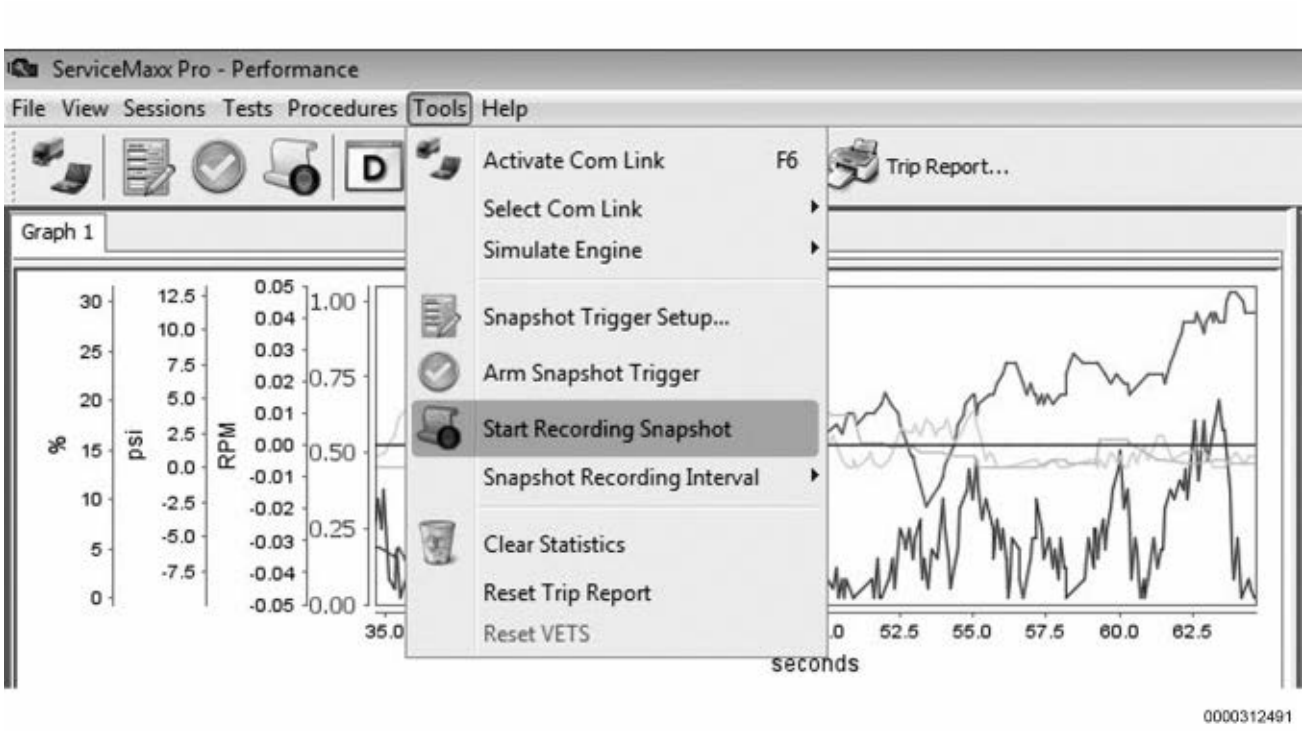


Figure 986 Menu – Select Start Recording Snapshot

4. Select Tools > Start Recording Snapshot (Figure 986).
5. When it is safe to do so, accelerate from 0 MPH to maximum allowed highway speed.
6. Repeat as necessary to reproduce complaint.

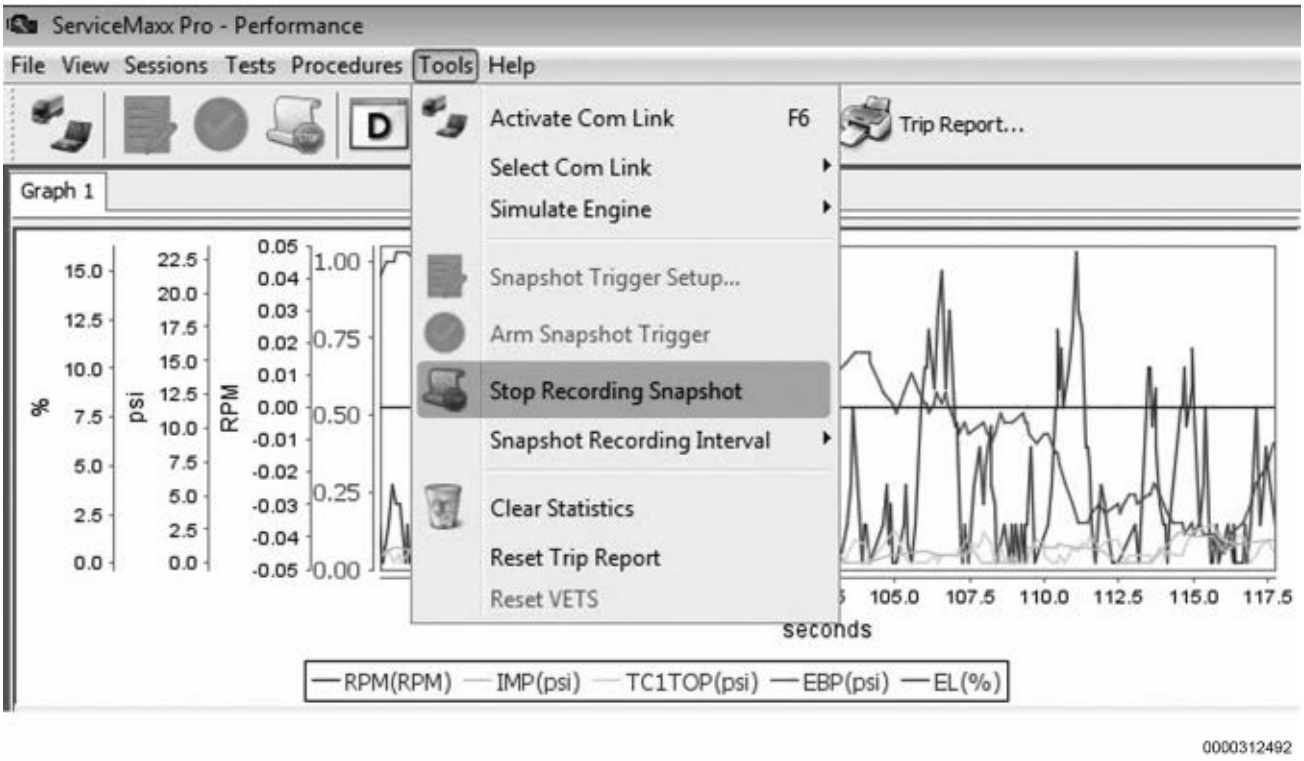


Figure 987 Menu – Select Stop Recording Snapshot

7. After test is complete, Select Tools > Stop Recording Snapshot (Figure 987) and save snapshot in EST.
8. Return to shop and review snapshot data.

Expected Outcome

Safely perform road test and record data for analysis.

Follow-on Procedure

None

0 to 60 MPH ICP and ICPD Graph

Overview

This graph shows an Injection Control Pressure (ICP) system operating as designed. This graph is a representation only, no two graphs will be exactly alike. This test does not give pass or fail results. It only allows the user to validate ICP and Injection Control Pressure Desired (ICPD) signal values under load. As engine rpm increases, ICP should steadily increase. Low ICP will cause low Intake Manifold Pressure (IMP). Diagnose low ICP concerns before diagnosing low IMP concerns.

NOTE: Analyze 0 to 60 MPH test signal values only during acceleration, and not during deceleration or shifting.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™
4. If not done previously, perform 0 to 60 MPH Test (0 to 60 MPH Test, page 2236) and save recording.

Test Procedure

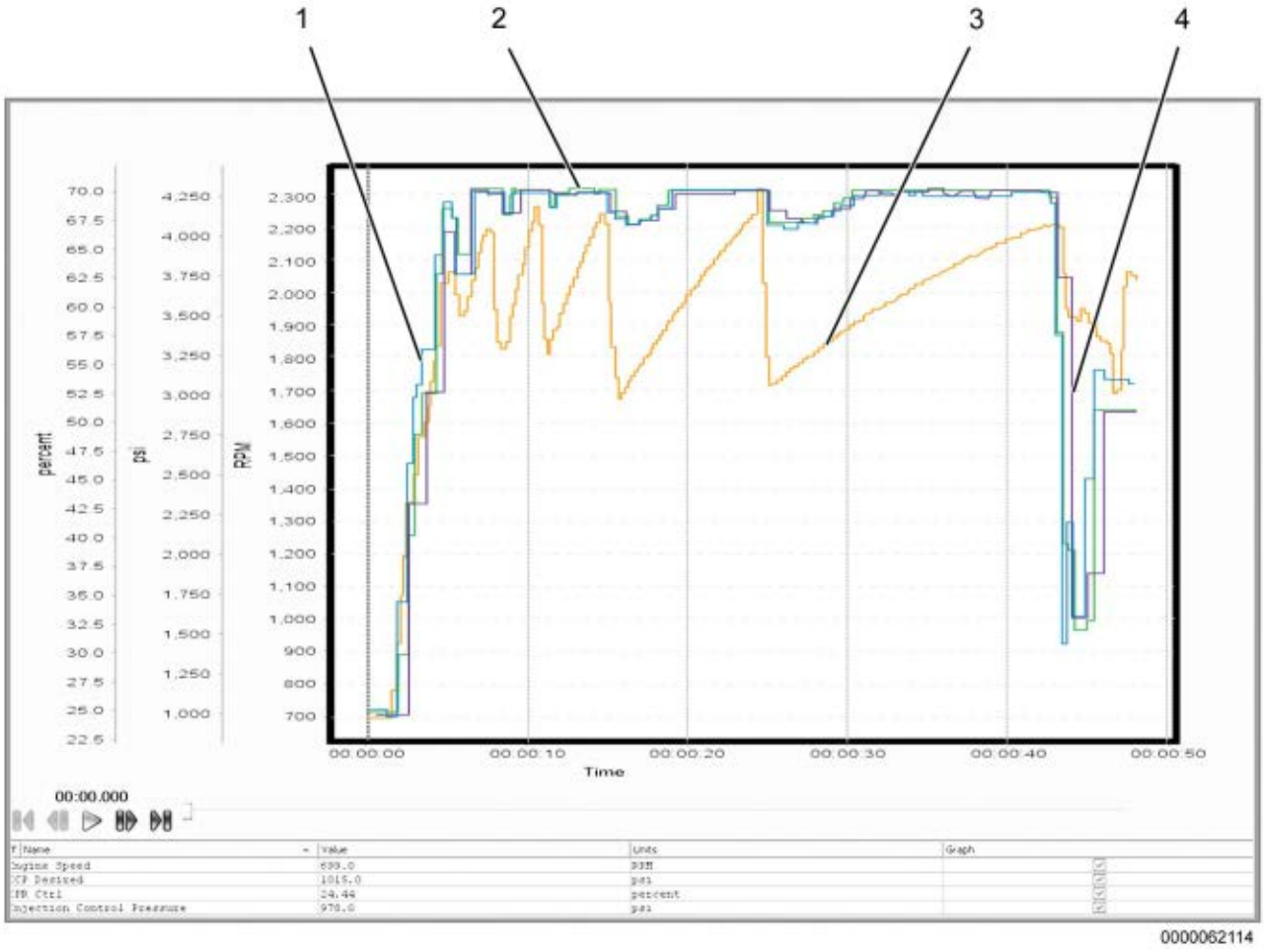


Figure 988 Injection Control Pressure and Injection Control Pressure Desired Graph

1. Injection Pressure Regulator (IPR) Valve control (percent) [Blue]
2. Injection Control Pressure Desired (ICPD) [Green]
3. Engine Speed (RPM) [Orange]
4. Injection Control Pressure (ICP) [Purple]

1. Verify if ICP is within 150 psi (1,034 kPa) of ICPD signal value during acceleration.
2. Verify if Injection Pressure Regulator (IPR) valve control is less than 80 percent.
3. Compare graph information with recorded data from test.

Expected Outcome

A properly-operating ICP system will closely resemble this graph.

Follow-On Procedure

None

0 to 60 MPH RPM, Load, IMP, EBP, and APP1 Graph

Overview

This graph shows the Intake Manifold Pressure (IMP) signal value operating as designed. This graph is a representation only, no two graphs will be exactly alike. This test does not give pass or fail results. It only allows the user to validate the IMP signal value under load. Accelerator Pedal Position 1 (APP1) signal value must be 99.6% to successfully reach peak boost during this test. Low IMP can be the result of low Injection Control Pressure (ICP). Diagnose low ICP concerns before diagnosing low IMP concerns. IMP can vary based on ECM calibration and vehicle weight. Using Electronic Service Tool (EST) with ServiceMaxx™ software, monitor turbocharger wastegate operation to verify low boost; IMP signal value may be as low as 29 psi (200 kPa) on lower horsepower configurations; Analyze 0 to 60 MPH Test signal values only during acceleration, not deceleration or shifting.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™
4. If not done previously, perform 0 to 60 MPH Test (0 to 60 MPH Test, page 2236) and save recording.

Test Procedure

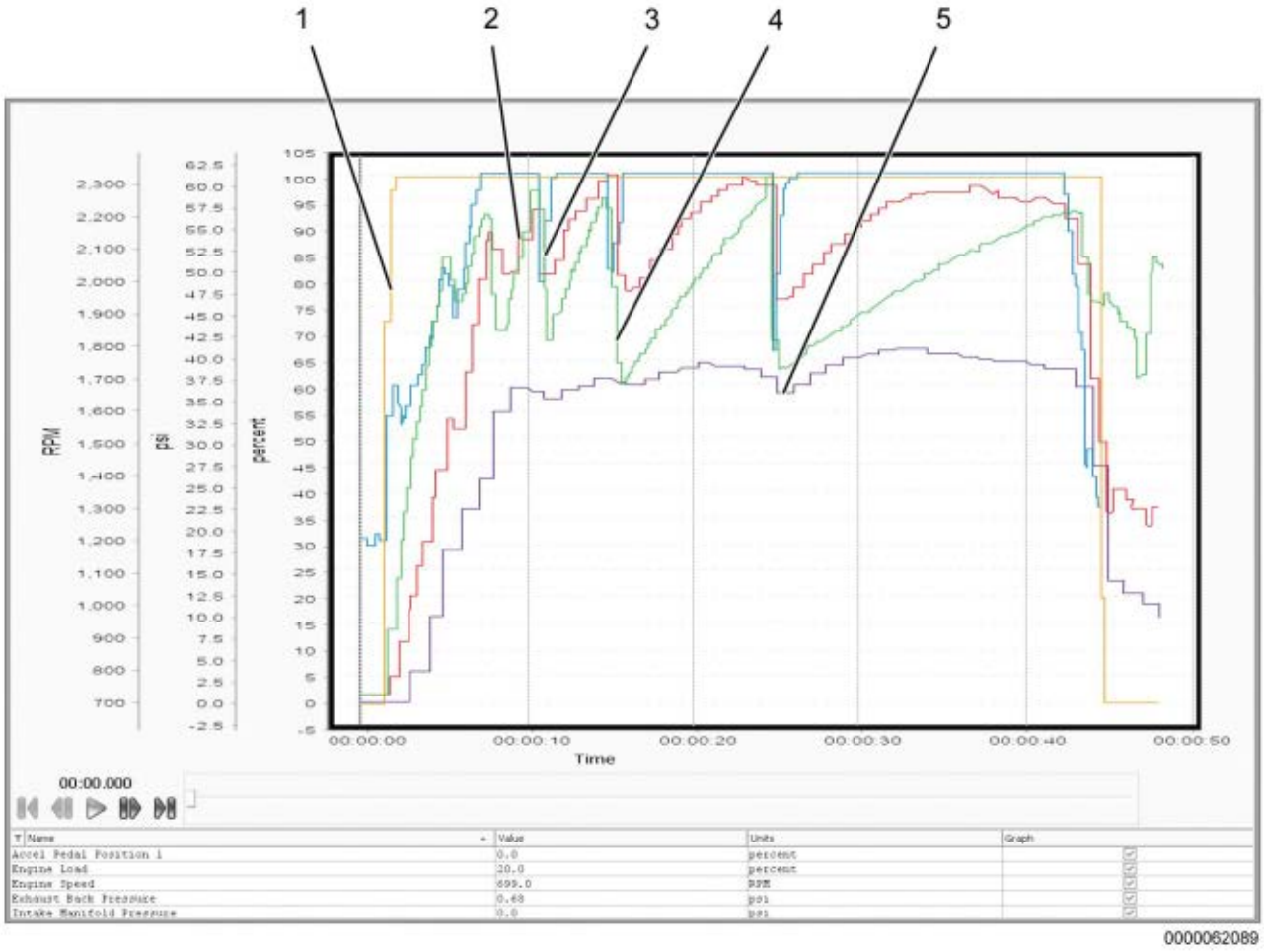


Figure 989 Intake Manifold Pressure Graph

1. Accelerator Pedal Position 1 (APP1) (percent) [Orange]
2. Exhaust Back Pressure (EBP) (psi) [Red]
3. Engine Load (percent) [Blue]
4. Engine Speed (RPM) [Green]
5. Intake Manifold Pressure (IMP) (psi) [Purple]

1. Verify IMP signal value is between 29 psi (200 kPa) to 42 psi (289 kPa), with APP1 signal value at 99.6 %, and engine speed between 1800 rpm to 2200 rpm.
2. Verify Exhaust Back Pressure (EBP) is less than 70 psi (482 kPa), with APP1 signal value at 99.6 %, and engine speed between 1800 rpm to 2200 rpm.
3. Compare graph information with recorded data from test.

Expected Outcome

Properly operating system signals will closely resemble this graph.

Follow-On Procedure

None

Normal Exhaust Gas Temperature Graph

Overview

This graph shows an aftertreatment system operating as designed. This test does not give pass or fail results. It only allows the user to validate operation of the aftertreatment system by monitoring exhaust gas temperatures.

NOTE: It is normal to see Diesel Oxidation Catalyst Intake Temperature (DOCIT), Diesel Particulate Filter Intake Temperature (DPFIT), and Diesel Particulate Filter Outlet Temperature (DPFOT) signal values fluctuate at the beginning and end of the Onboard Filter Cleanliness Test (OBFCT). A snapshot is recorded below with Diesel Particulate Filter (DPF) soot load level 1.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ (page 2096).
4. Perform Onboard Filter Cleanliness Test (OBFCT) if not already done and saved.

Test Procedure

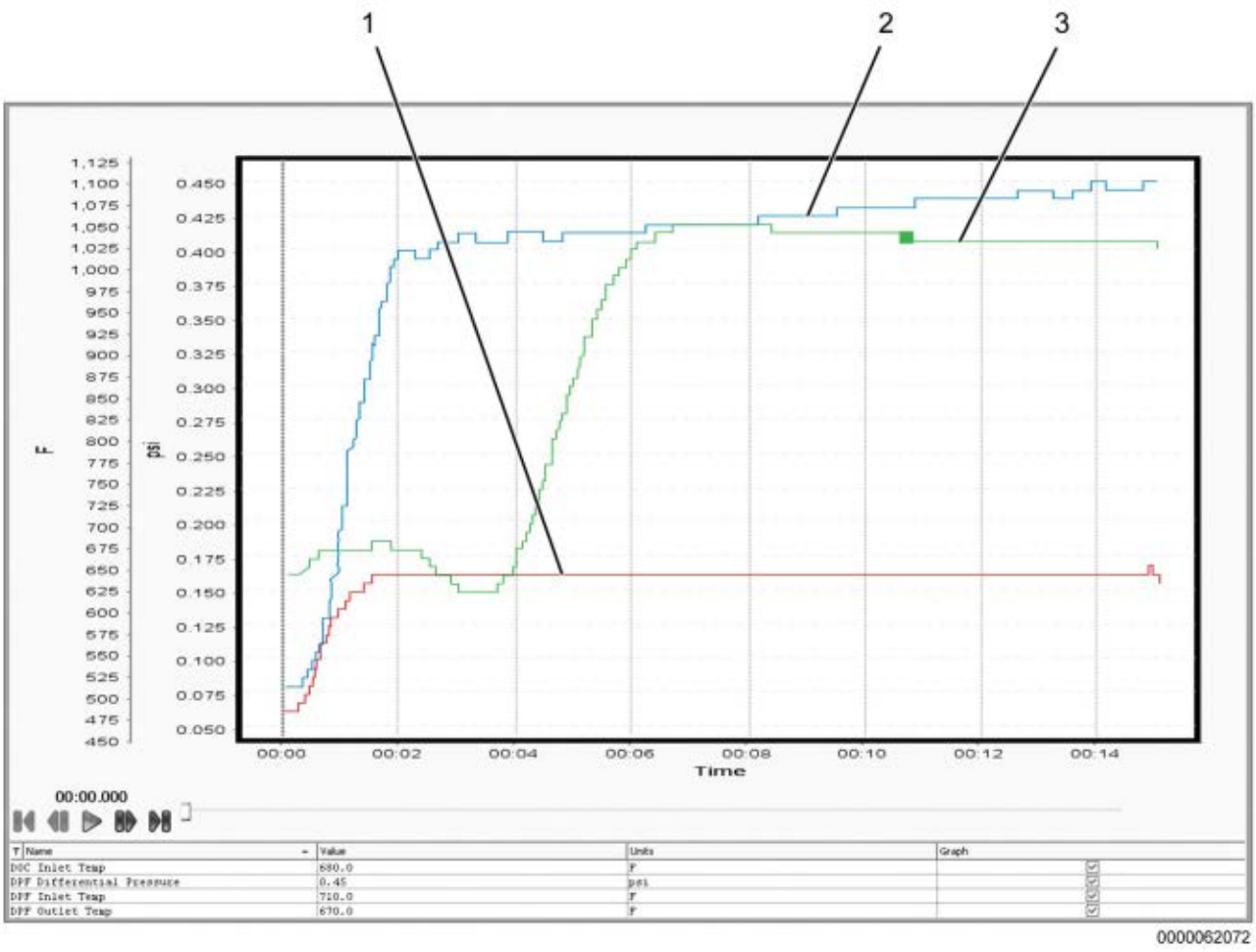


Figure 990 Normal Exhaust Gas Temperatures

1. Diesel Oxidation Catalyst Intake Temperature (DOCIT) (degrees Fahrenheit)
2. Diesel Particulate Filter Intake Temperature (DPFIT) (degrees Fahrenheit)
3. Diesel Particulate Filter Outlet Temperature (DPFOT) (degrees Fahrenheit)

1. Compare graph information with recorded data from test.
2. After Diesel Oxidation Catalyst (DOC) reaches operating temperature and stabilizes, verify DPFIT signal value is at approximate target temperature for current soot load level (see Soot Load Level vs. Exhaust Gas Target Temperature Chart).
3. Verify DOCIT signal value is between 550°F (287°C) to 800°F (427°C).

Expected Outcome

An aftertreatment system that is working properly will have signals that will be close to this graph.

Follow-On Procedure

None

Erratic Exhaust Gas Temperatures Graph

Overview

This graph shows erratic exhaust gas temperatures. Erratic temperatures in the exhaust stream occur when the Diesel Oxidation Catalyst (DOC) becomes contaminated, or an issue with the Aftertreatment Fuel Injector (AFI) is present. This test does not give pass or fail results. It only allows the user to validate operation of the aftertreatment system by monitoring exhaust gas temperatures.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ (page 2096).
4. Perform Onboard Filter Cleanliness Test (OBFCT) if not already done and saved.

Test Procedure

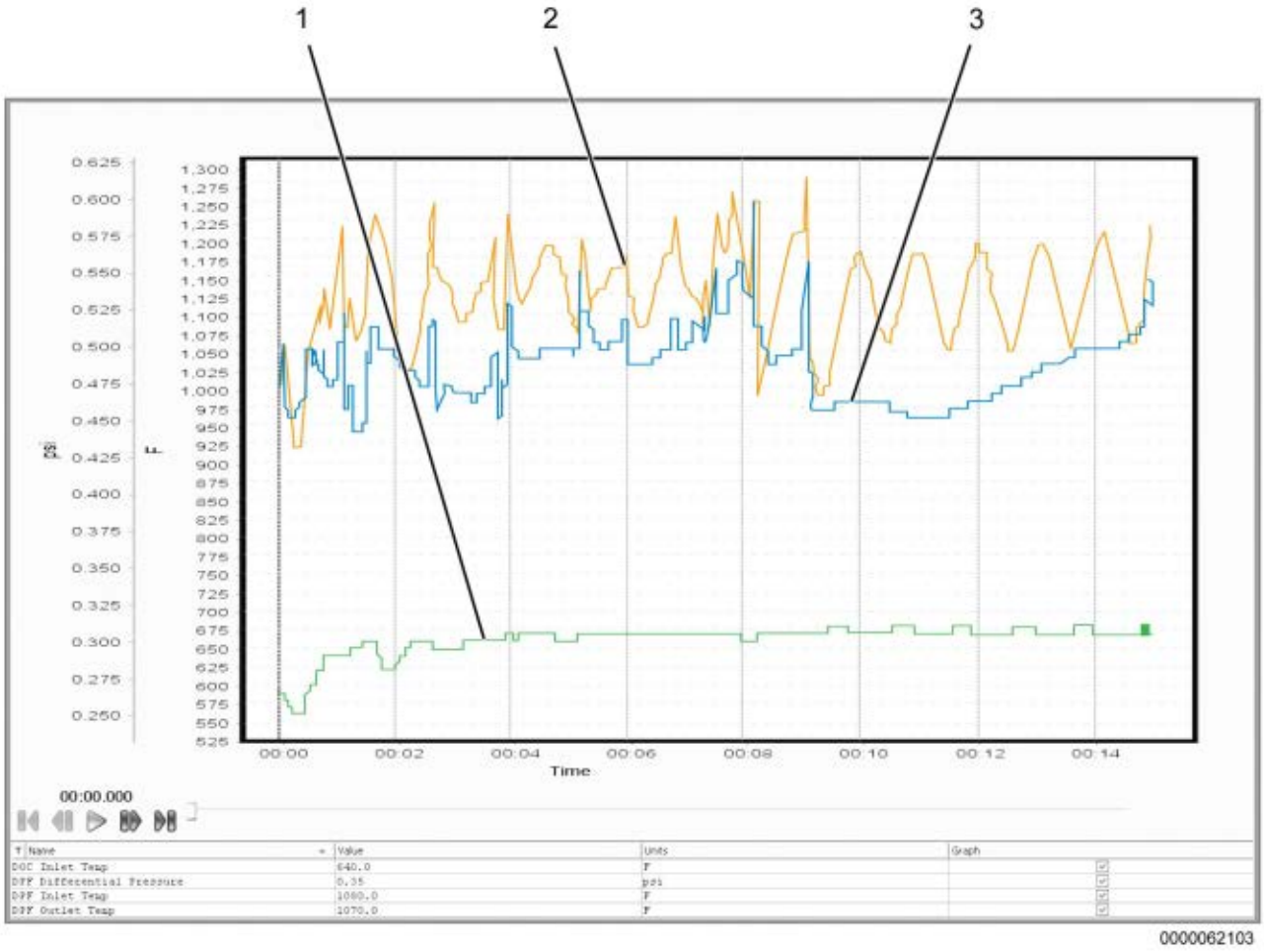


Figure 991 Graph Information Identification

1. Diesel Particulate Filter Intake Temperature (DPFIT) (degrees Fahrenheit)
2. Diesel Particulate Filter Outlet Temperature (DPFOT) (degrees Fahrenheit)
3. Diesel Oxidation Catalyst Intake Temperature (DOCIT) (degrees Fahrenheit)

1. Compare graph information with recorded data from test.
2. After Diesel Oxidation Catalyst (DOC) reaches operating temperature, verify Diesel Particulate Filter Intake Temperature (DPFIT) and Diesel Particulate Filter Outlet Temperature (DPFOT) signal values do not fluctuate more than 50°F (10°C) within 2 minutes. In this graph, DPFIT and DPFOT fluctuate more than 50°F (10°C) within 2 minutes.

Expected Outcome

Exhaust gas temperatures that fluctuate more than specified will have signal values that match this graph.

Follow-On Procedure

None

Low Exhaust Gas Temperatures Graph

Overview

This graph shows low exhaust gas temperatures indicating a restricted Aftertreatment Fuel Injector (AFI). Low temperatures in the exhaust stream occur when fuel flow from the AFI is restricted, resulting in less fuel burning in the exhaust stream. This test does not give pass or fail results. It only allows the user to validate operation of the aftertreatment system by monitoring exhaust gas temperatures.

NOTE: It is normal to see Diesel Oxidation Catalyst Intake Temperature (DOCIT), Diesel Particulate Filter Intake Temperature (DPFIT), and Diesel Particulate Filter Outlet Temperature (DPFOT) signal values fluctuate at the beginning and end of the Onboard Filter Cleanliness Test (OBFCT). A snapshot is recorded below with Diesel Particulate Filter (DPF) soot load level 1.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.
4. Perform OBFCT if not already done and saved.

Test Procedure

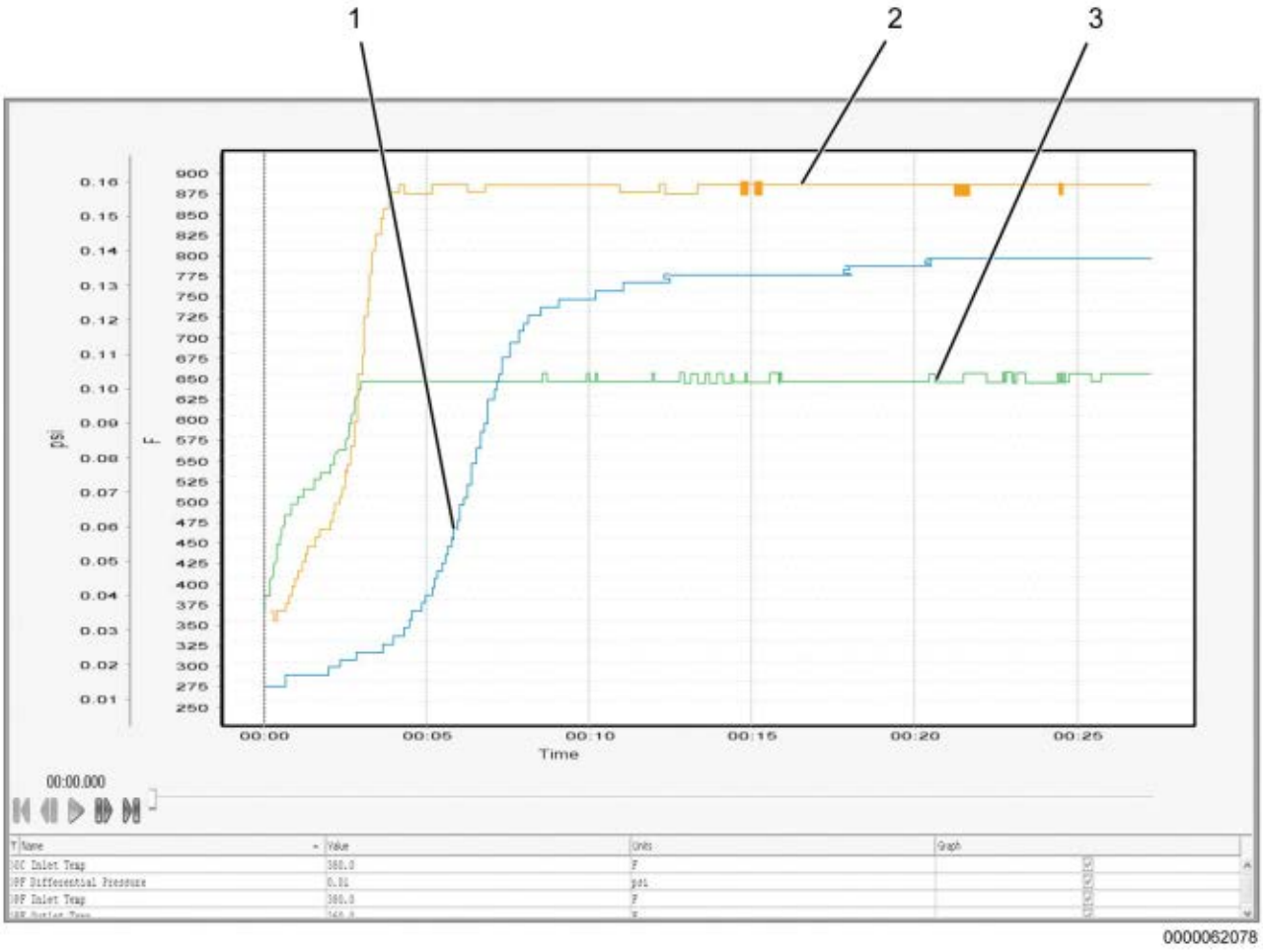


Figure 992 Low Exhaust Gas Temperatures

1. Diesel Particulate Filter Intake Temperature (DPFIT) (degrees Fahrenheit)
2. Diesel Particulate Filter Outlet Temperature (DPFOT) (degrees Fahrenheit)
3. Diesel Oxidation Catalyst Intake Temperature (DOCIT) (degrees Fahrenheit)

1. Compare graph information with recorded data from test.
2. After Diesel Oxidation Catalyst (DOC) reaches operating temperature and stabilizes, verify DPFIT signal value is at approximate target temperature for current soot load level (see Soot Load Level vs. Exhaust Gas Target Temperature Chart).
3. Verify DOCIT signal value is between 550°F (287°C) to 800°F (427°C).

Expected Outcome

An aftertreatment system with low exhaust gas temperatures indicative of a restricted AFI, will have signal values that match this graph .

Follow-On Procedure

None

Air Control Valve (ACV) Test

Exhaust Back Pressure Valve (EBPV) Test

Overview

This test measures the performance of the Exhaust Back Pressure Valve (EBPV). This visual and functional test uses pre-programmed actions of the Engine Control Module (ECM) to cycle the EBPV three times after the key is turned off.

Tools Required

None

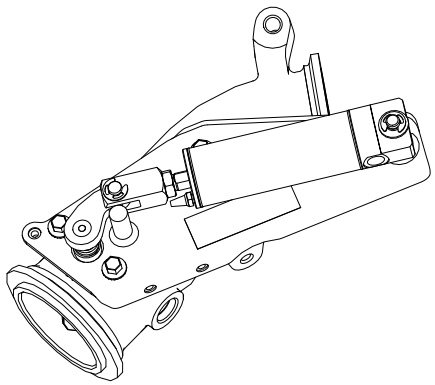
Equipment Condition

Remove truck-mounted components as necessary to have a clear view, and to allow access to EBPV.

Test Setup

1. Key-On Engine-Off (KOEO).
2. Ensure air tanks are full.

Test Procedure



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Figure 993 Exhaust Back Pressure Valve (EBPV)

1. Start engine and let it idle for a minimum of 5 seconds.
2. Shut engine off and visually monitor EBPV (Figure 993) for movement (if necessary, use a helper):
   - If EBPV cycles fully open and fully closed, it is working.
   - If EBPV does not cycle, go to next step.
3. Disconnect air supply to EBPV.
4. Start engine and let it idle for a minimum of 5 seconds.
5. Shut engine off and check for airflow to the EBPV (if necessary, use a helper):
   - If airflow cannot be heard or felt, go to EBPV control diagnostics.

- If airflow can be heard or felt go to next step.

6. Check EBPV and linkage for binding and sticking.

Expected Outcome

The EBPV will cycle fully open and closed three times when the key is turned off.

Follow-on Procedure

None

Boost Control System Test

Overview

Verify operation and condition of boost control system. This test is made up of multiple inspections and tests to determine root cause of boost control system failures. All tests may not need to be performed. If any test identifies a failed component, replace that component and retest for original symptom.

CAUTION: Limit supply air pressure to 21.5 PSI (148 kPa) to prevent damage to system lines, hoses, and Turbocharger 2 Wastegate (TC2WG) solenoid.

Tools Required

- Pressure Test Kit ZTSE4409

Equipment Condition

None

Test Setup

None

Test Procedure

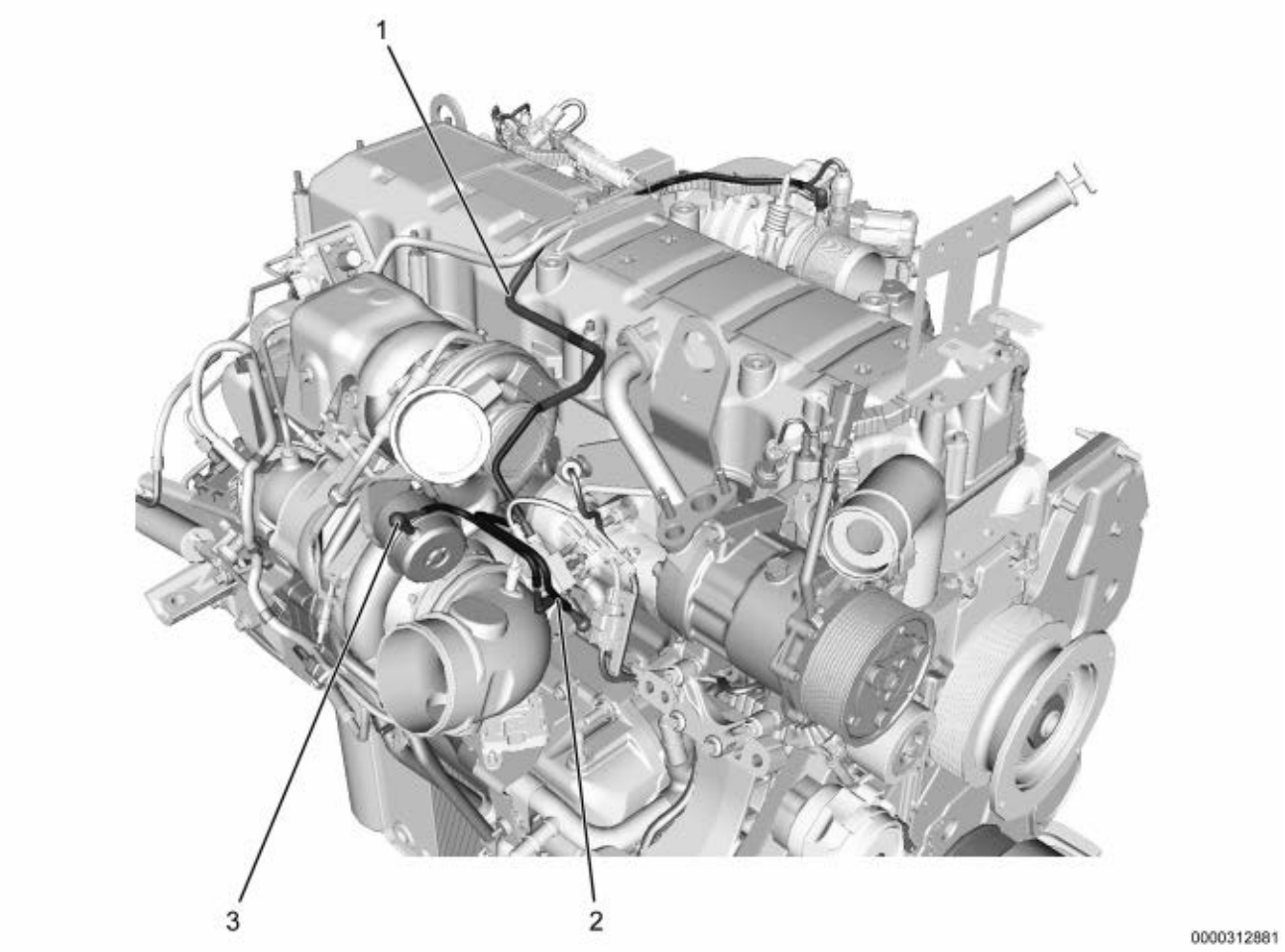


Figure 994 Boost Control System Lines - Shown with Interstage Cooler (ISC) Removed for Clarity

1. Supply line
2. Dump line
3. Wastegate actuator line

1. Perform visual inspection of Turbocharger 2 Wastegate (TC2WG) solenoid supply line, Wastegate Actuator and dump lines (Figure 994).
2. Perform Turbocharger 2 Wastegate (TC2WG) Operational Test (page 2259). If test passes, got to step 5.

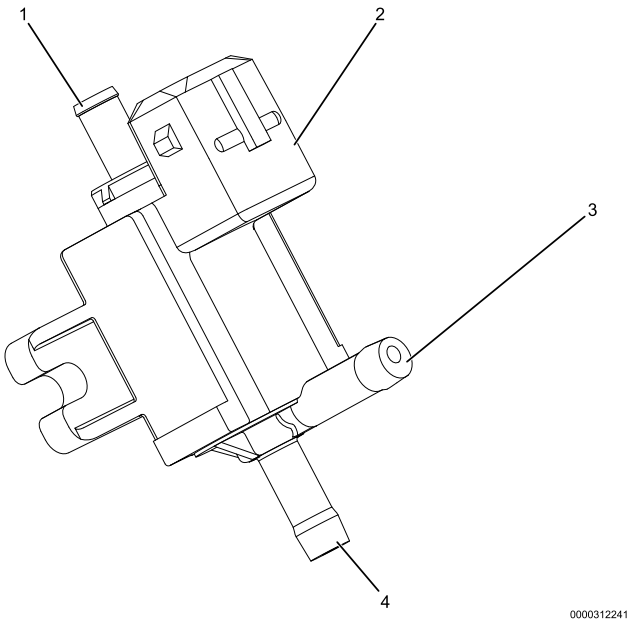


Figure 995 Turbocharger 2 Wastegate (TC2WG) Solenoid

1. Supply port
2. Electrical connector
3. Wastegate actuator port
4. Dump port

3. Check electrical connector (Figure 995) (Item 2) for bent, loose, damaged, or corroded pins and repair as needed.
4. Start Engine and blow air pressure (21.5 psi or 148 kPa) through supply line. Air should not pass through solenoid. If air passes through, replace TC2WG solenoid.
5. Perform Turbocharger 2 Wastegate (TC2WG) Solenoid Test (page 2263). If test passes, got to step 6.
6. Perform Turbocharger 2 Wastegate (TC2WG) Isolated Actuator Test (page 2264). If test passes, go to Step 7.
7. Perform Exhaust Back Pressure Valve Operation Test (page 2254).

Expected Outcome

Testing will diagnose faulty component causing failure of boost control system.

Follow-On Procedure

None

Turbocharger 2 Wastegate Position (TC2WG) Operational Test

Overview

Verify turbocharger wastegate is operating properly. This test verifies appropriate travel of wastegate actuator rod. Actuator rod travel should match specification.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

Tools Required

- Pressure Test Kit ZTSE4409
- Measuring tool (ruler)

Equipment Condition

Remove any necessary truck components to achieve a clear view of and to reach turbocharger wastegate actuator.

Test Setup

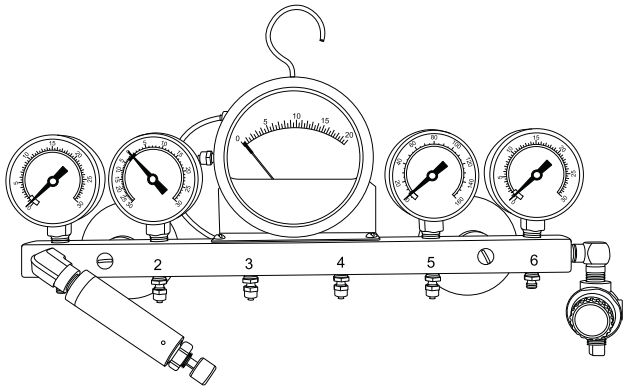
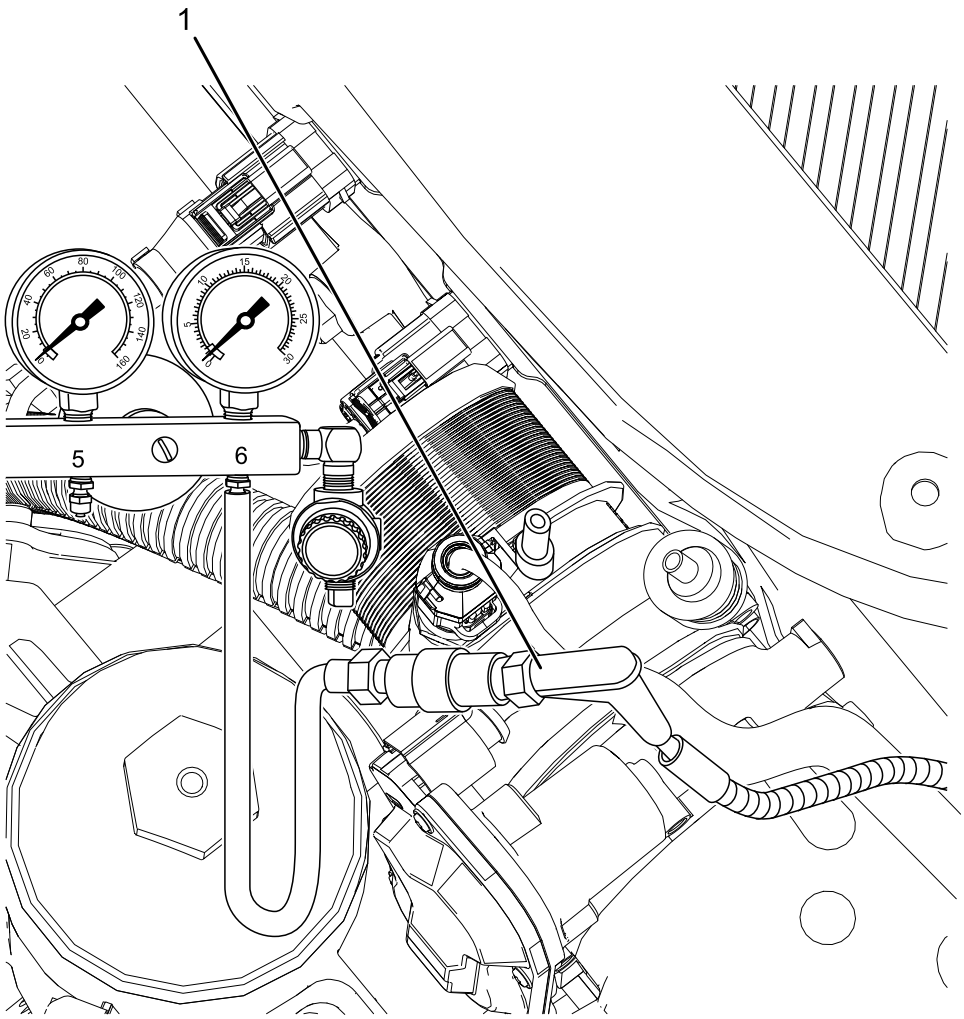


Figure 996 ZTSE4409



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Figure 997 Installing Pressure Gauge ZTSE4409

1. Pressure Test Gauge connected to air supply

1. Install Pressure Test Gauge ZTSE4409 (Figure 997) (Item 1) to wastegate actuator air supply, and then connect to regulated air pressure.

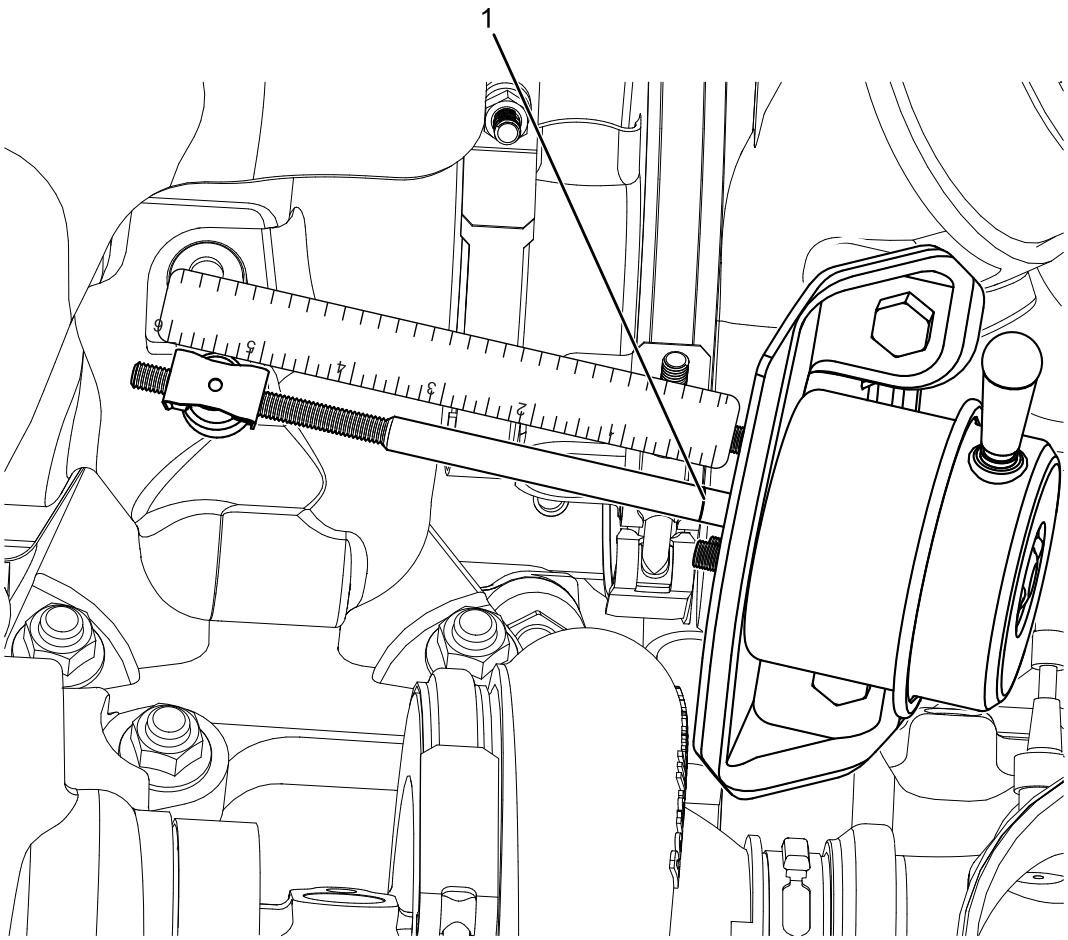


Figure 998 Marking Actuator Rod

1. Actuator rod mark

2. Mark actuator rod (Figure 1000) (Item 1) at base of actuator.
3. Inspect air hoses for chafing, leaks, and splits.

Test Procedure

1. Apply 21.5 psi (148 kPa) of regulated air pressure to actuator.
2. Measure actuator rod movement.

Expected Outcome

Turbocharger wastegate actuator rod will travel its full range of motion and stop in a seated position without sticking or shuddering. Length of travel will match specification.

Follow-On Procedure

None

Turbocharger 2 Wastegate Position (TC2WG) Solenoid Test

Overview

Test for proper operation of turbocharger Wastegate Position system. This test verifies air and electrical controls of turbocharger wastegate. ServiceMaxx™ software commands system on and off.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant supporting J1939 and J1708)
- Pressure Test Kit - ZTSE4409

Equipment Condition

Remove any necessary truck components to achieve a clear view and reach to turbocharger wastegate actuator and control valve.

Test Setup

1. Key-On Engine-Off (KOEO).
2. Attach pressure test kit to Supply hose to TC2WG solenoid.
3. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
4. Log in to ServiceMaxx™ software.

Test Procedure

1. Perform KOEO Standard Test (Figure 882)
2. Supply 21.5 psi (148 kPa) to TC2WG solenoid.
3. After test is complete, perform KOEO Output State Low Test (Figure 887) and visually monitor turbocharger wastegate actuator.
4. Perform KOEO Output State High Test (Figure 888) and visually monitor turbocharger wastegate actuator.
5. Supply 8 psi (55 kPa) to TC2WG solenoid.
6. Perform KOEO Output State Low Test (Figure 887), actuator should NOT move.
7. Perform KOEO Output State High Test (Figure 888), actuator should NOT move.

Expected Outcome

The turbocharger wastegate actuator will cycle fully open and closed during Output State Low and High Tests with 21.5 psi (148 kPa) supplied to it, indicating it is working properly.

Follow-On Procedure

None

Turbocharger 2 Wastegate Position (TC2WG) Isolated Actuator Test

Overview

This test checks for which part of wastegate system not functioning correctly by isolating and checking primary components.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

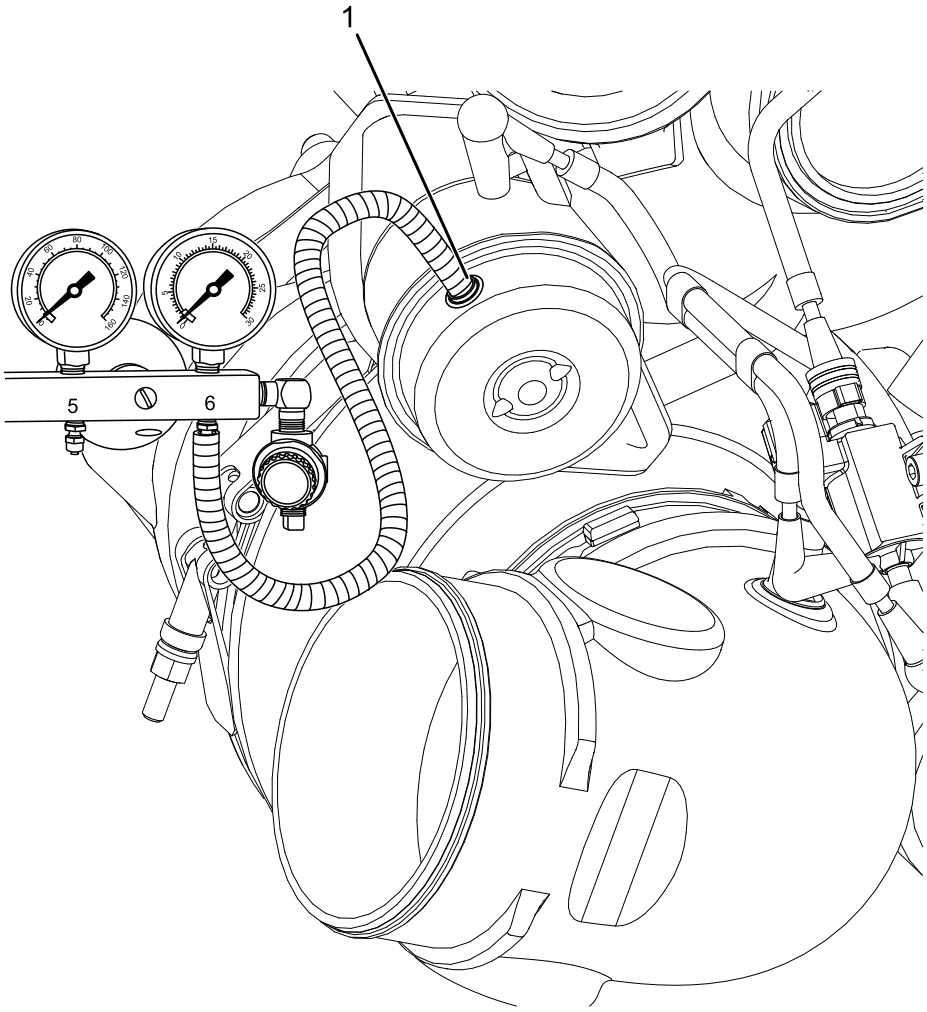
Tools Required

- Pressure Test Kit ZTSE4409
- Measuring tool (ruler)

Equipment Condition

Remove any necessary truck components to achieve a clear view of and to reach turbocharger wastegate actuator.

Test Setup

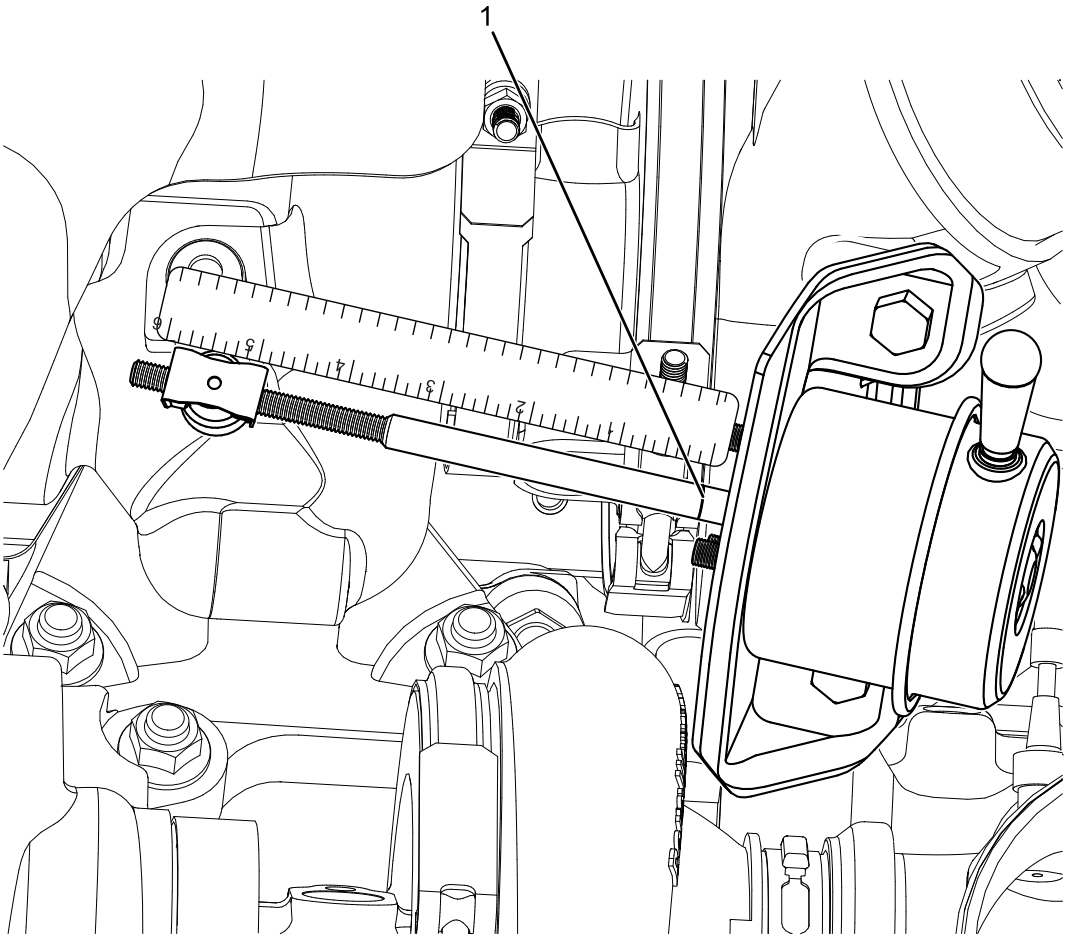


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Figure 999 Installing Pressure Gauge ZTSE4409

1. Turbocharger Wastegate Actuator

1. Install Pressure Test Gauge (ZTSE4409) directly to wastegate actuator (Figure 999) (Item 1), and connect to regulated air pressure.



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Figure 1000 Marking Actuator Rod

1. Actuator rod mark

2. Mark actuator rod (Figure 1000) (Item 1) at the base of actuator.
3. Inspect air hoses for chafing, leaks, and splits.

Test Procedure

1. Apply 21.5 psi (148 kPa) of regulated air pressure to actuator.
2. Measure actuator rod movement.
3. Relieve regulated air pressure from actuator.



Figure 1001 Actuator Rod Removal

4. If rod does not move, remove actuator rod (Figure 1001) from turbocharger wastegate arm (see *Engine Service Manual*).
5. Move turbocharger wastegate lever by hand.

Expected Outcome

Turbocharger wastegate actuator moves without sticking or shuddering. Turbocharger wastegate lever moves freely by hand.

Follow-On Procedure

None

KOER MAF Sensor Calibrations

Overview

The Mass Air Flow (MAF) sensor directly monitors the air entering the engine. The MAF sensor is used to calculate the amount and density of the incoming air. The Engine Control Module (ECM) uses this information to calculate the correct amount of Exhaust Gas Recirculation (EGR) during engine operation. This test displays pass, fail or abort results.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software.
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

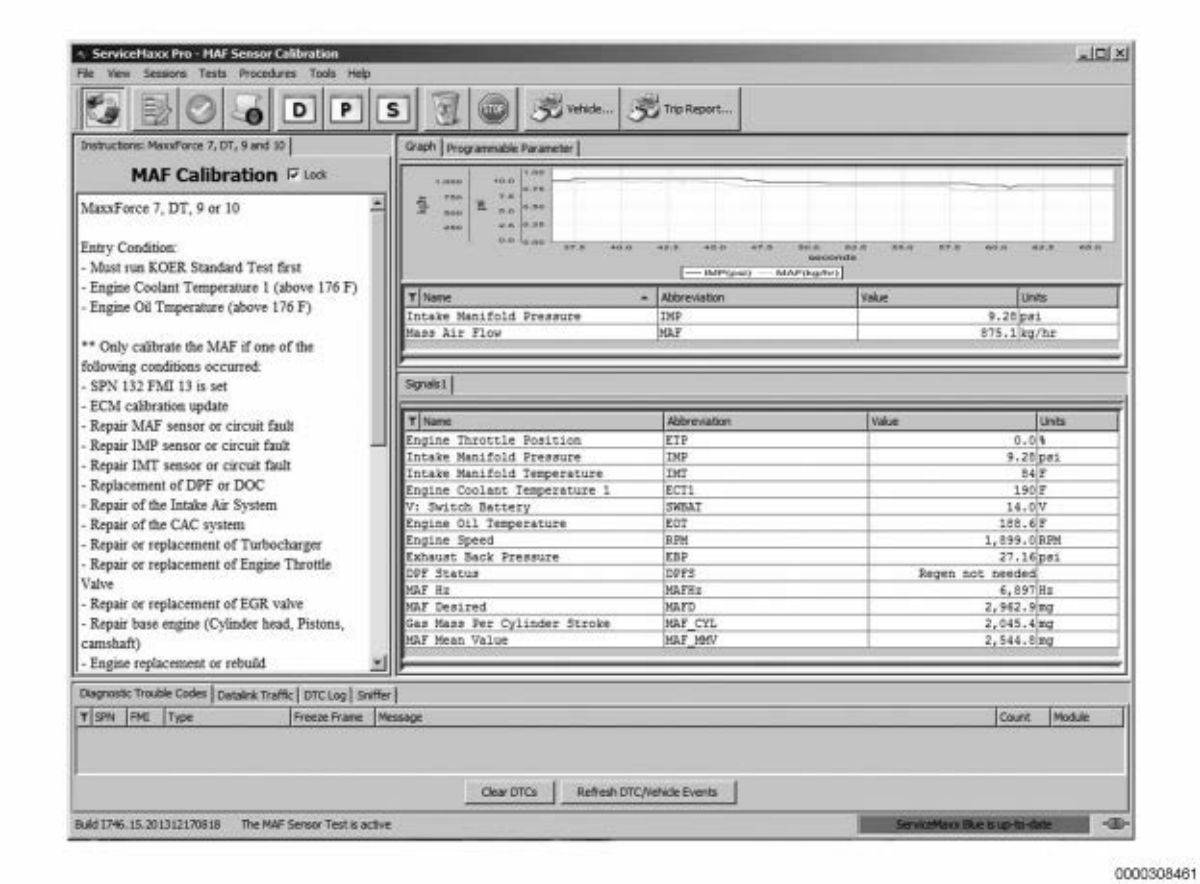
Equipment Condition

- Engine speed below 700 RPM
- Key-On Engine-Running (KOER) Standard Test run.
- Engine Coolant Temperature 1 (ECT1) at or above 158°F (70°C)
- Engine Oil Temperature (EOT) above 176°F (80°C)
- Vehicle not moving
- Accelerator Pedal Position (APP) at 0%
- Brake pedal released
- Clutch pedal released

MAF Calibration Pre-Checks

- No active fault codes, other than SPN 132 FMI 13.
- Ambient Air Temperature (AAT) at or above 58°F (14°C).
- Diesel Particulate Filter (DPF) Status = regeneration not needed.
- No leaks in intake air system.
- No leaks in exhaust system.
- No shop exhaust hose attached.
- No engine performance issues.
- No engine misfire issues.
- Vehicle hood is closed.
- Transmission in Park or Neutral.
- Clutch pedal released
- Engine Fan OFF.
- Park Brake Applied.
- Power Takeoff (PTO) disabled.

- Air conditioning OFF.
- Accelerator pedal not pressed
- Mass Air Flow (MAF) sensor within Key-On Engine-Off (KOEO) specification.
- Intake Manifold Pressure (IMP) sensor within KOEO specification.
- Intake Manifold Temperature (IMT) sensor within -22°F (-30°C) and 257°F (125°C)



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Figure 1002 MAF Sensor Calibration

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle diagnostic connector (page 2124).
3. Start ServiceMaxx™ software (page 2124).
4. Perform KOEO Standard Test (page 2136).

Test Procedure



Figure 1003 Menu – Select Test

1. Start engine and run to operating temperature.
2. Select Procedures > KOER Procedures > MAF Sensor Calibration (Figure 1003).

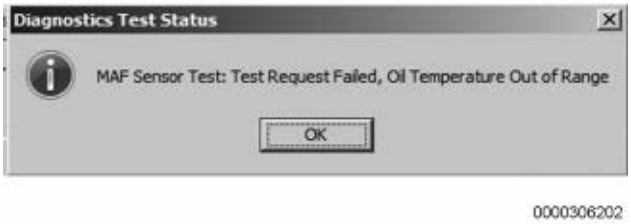


Figure 1004 Test Abort Temperature Out of Range

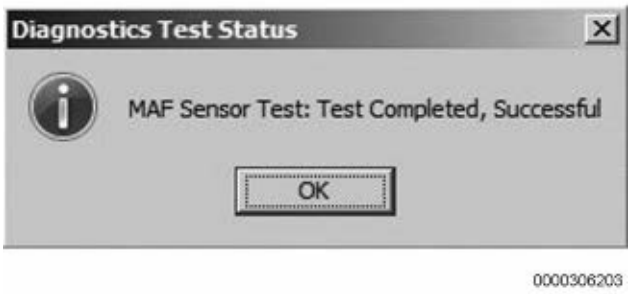


Figure 1005 Test Complete

3. Click OK (Figure 1005) when the test is complete to return to ServiceMaxx™ homescreen.

Expected Outcome

Test will run successfully and give pass results.

Follow-On Procedure

None

Exhaust Gas Recirculation (EGR) Valve Operational Test

Overview

This test commands the Exhaust Gas Recirculation (EGR) valve to perform a self-diagnostic routine and broadcast a fault code if there is a problem. The test commands the EGR valve completely open, waits for a significant dwell time, commands the EGR valve completely closed, waits for a significant dwell time, and repeats the test multiple times. The long dwell times and repeating tests are important. A stuck EGR valve will broadcast an SPN 2791 FMI 7 fault code. Allowing at least 30 seconds between Output State tests in step 3 is critical. Output State tests will not finish without a minimum of 30 seconds between them. This is a manually-controlled test.

Tool Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO)
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Perform KOEO Standard Test (page 2136).

Test Procedure

1. Key OFF for minimum of 45 seconds before testing.

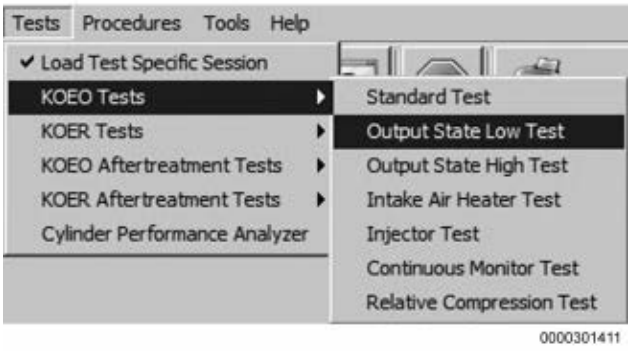


Figure 1006 Tests – Output State Low

2. Select Tests > KOEO Tests > Output State Low Test (Figure 1006) and wait 30 seconds for test to run.

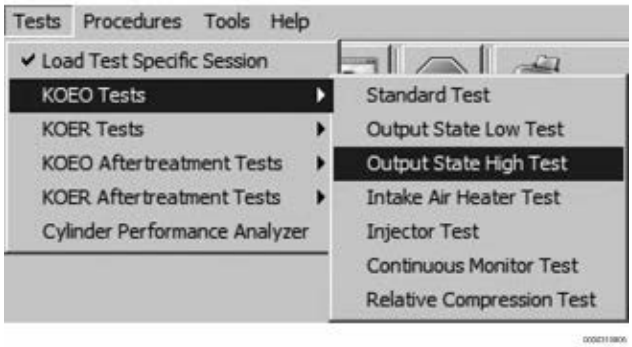


Figure 1007 Tests – Output State High

3. Select Tests > KOEO Tests > Output State High Test (Figure 1007) and wait 30 seconds for test to run.
4. Repeat step 2 and step 3 in sequence three more times, waiting 30 seconds for each test to run.

Expected Outcome

A free-moving Exhaust Gas Recirculation (EGR) valve will not broadcast an SPN 2971 FMI 7 fault code during the EGRV Operation Test. A stuck EGR valve will broadcast an SPN 2971 FMI 7 fault code.

Follow-On Maintenance

None

Low-pressure Fuel System Tests

Fuel Delivery Pressure (FDP) Test

Overview

This test verifies proper operation of the Fuel Delivery Pressure (FDP) system. FDP must be within specification to ensure proper performance of engine.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flame and sparks.

GOVERNMENT REGULATION: Engine fluid (oil, fuel, and coolant) may be a hazard to human health and the environment. Handle all fluid and other contaminated materials (e.g. filters rags) in accordance with applicable regulations. Recycle or dispose of engine fluids, filters, and other contaminated materials according to applicable regulations.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Fuel Pressure Gauge ZTSE4681
- Fuel / Oil Pressure Test Coupler (Compucheck) ZTSE4526
- Fuel Pressure Test Kit ZTSE4657
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

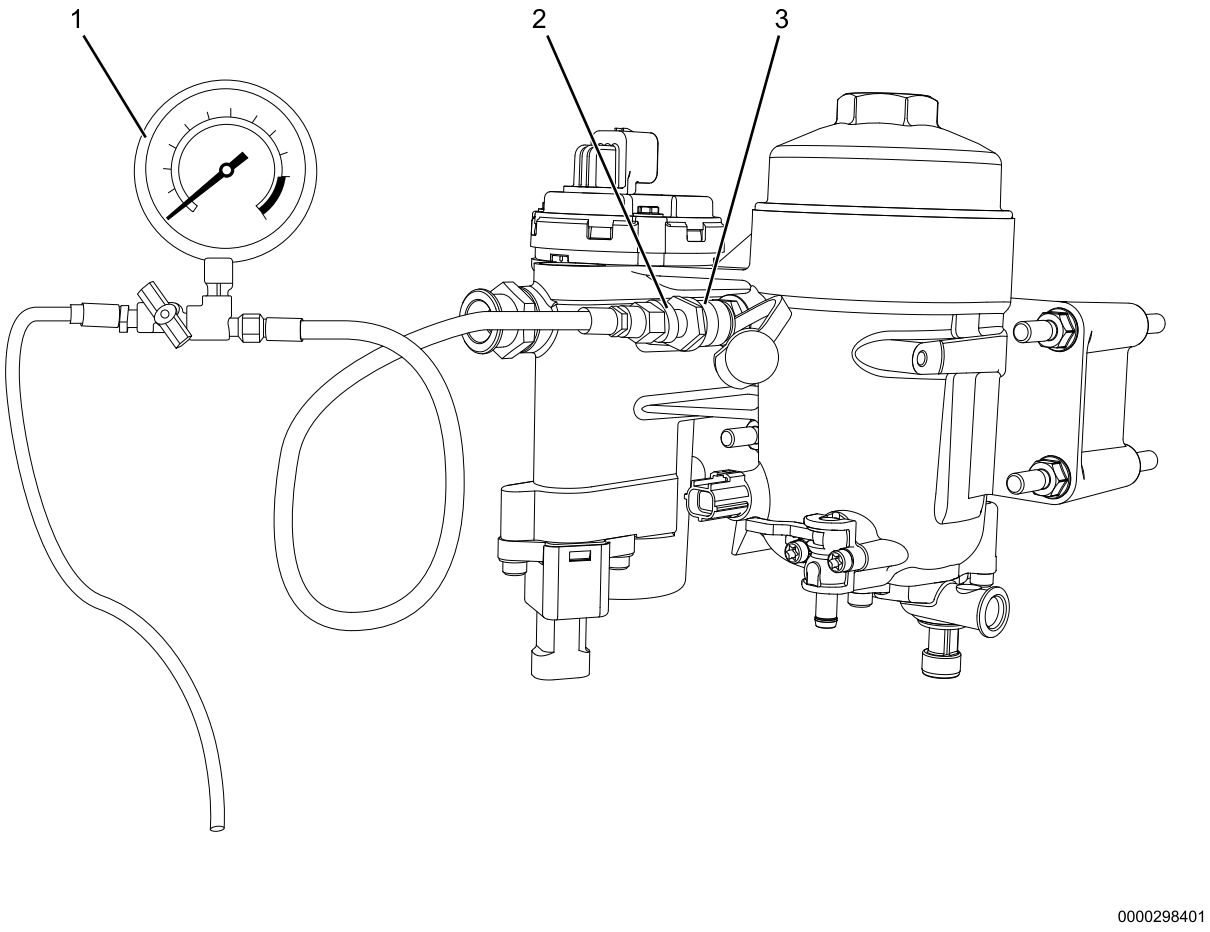
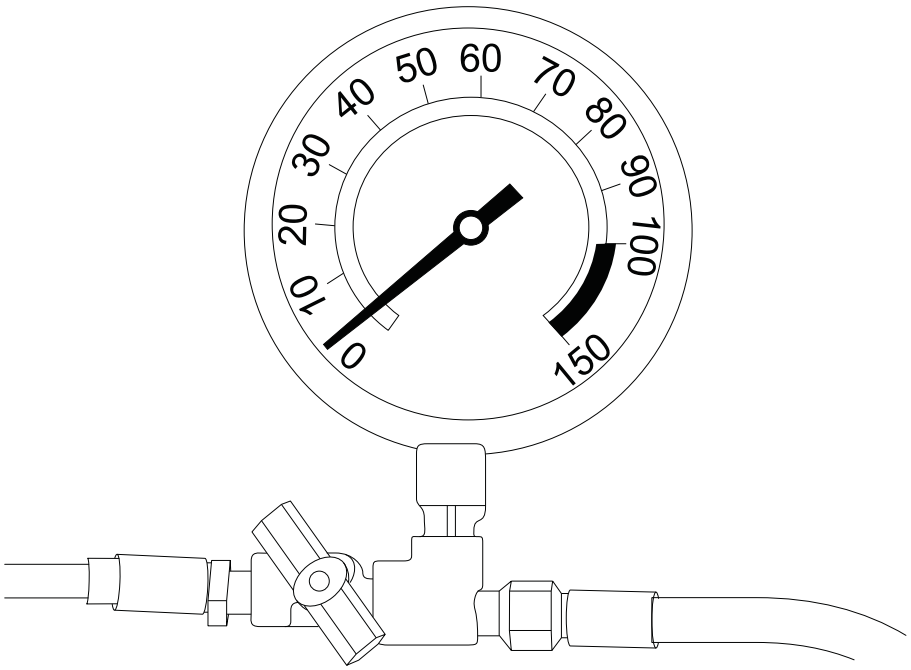


Figure 1008 Fuel Pressure Gauge to Fuel Filter Module Connection

1. Fuel Pressure Gauge ZTSE4681
2. Fuel Pressure Test Kit ZTSE4657
3. Fuel / Oil Pressure Test Coupler ZTSE4526

1. Key OFF.
2. Fuel Pressure Gauge ZTSE4681 (Figure 1008) (Item 1) connected to Fuel Filter Module test port.
3. Valve closed on fuel gauge.
4. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
5. Log into ServiceMaxx™ software.

Test Procedure



0000306802

Figure 1009 Fuel Pressure Gauge ZTSE4681

1. Turn Key-On Engine-Off (KOEO) to energize fuel pump (pump will run for 10 to 20 seconds).
2. Monitor and record fuel pressure displayed on gauge.
3. Turn key Off for a minimum of 30 seconds, allowing Engine Control Module (ECM) to reset.
4. Electric Fuel Pump can also be commanded on by using Output State High Test in ServiceMaxx™ software.
5. Perform Output State High Test (page 2145) and monitor gauge and sensor signal in ServiceMaxx™ software.
6. Repeat as necessary to get an accurate and steady pressure reading.

Expected Outcome

Fuel Delivery Pressure (FDP) will be within specifications .

Follow-On Procedure

None

Fuel Pump Voltage Test

Overview

This test is used to determine if the Engine Control Module (ECM) is commanding the Electric Fuel Pump (EFP) by measuring supply voltage to the EFP.

NOTE: Output state high test can be used to activate fuel pump.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Digital Multimeter (DMM)
- Electric Fuel Pump (EFP) Breakout Harness ZTSE6023
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

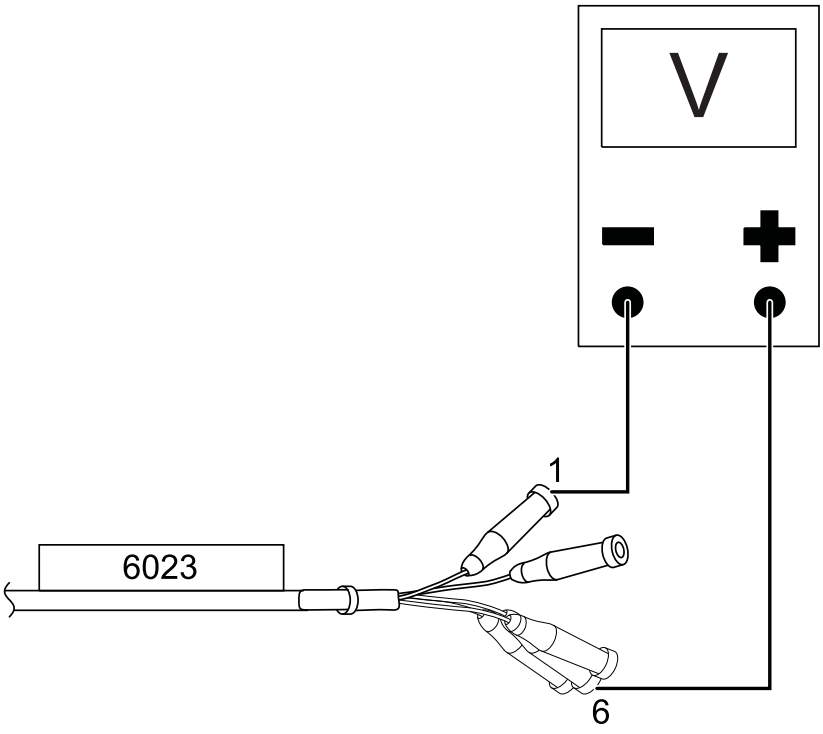
Equipment Condition

None

Test Setup

1. Key OFF.
2. Install Breakout Harness ZTSE6023 between Electric Fuel Pump (EFP) and EFP harness connector.
3. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
4. Log into ServiceMaxx™ software.

Test Procedure



0000301741

Figure 1010 Pin-Point Test 1

1. Use ServiceMaxx™ and the Output State Test HIGH (page 2145)to command fuel pump On.
2. While Electric Fuel Pump (EFP) is energized, use Digital Multimeter (DMM) to measure voltage between Breakout Harness ZTSE6023, pin-6, and pin-1. Record measurement.

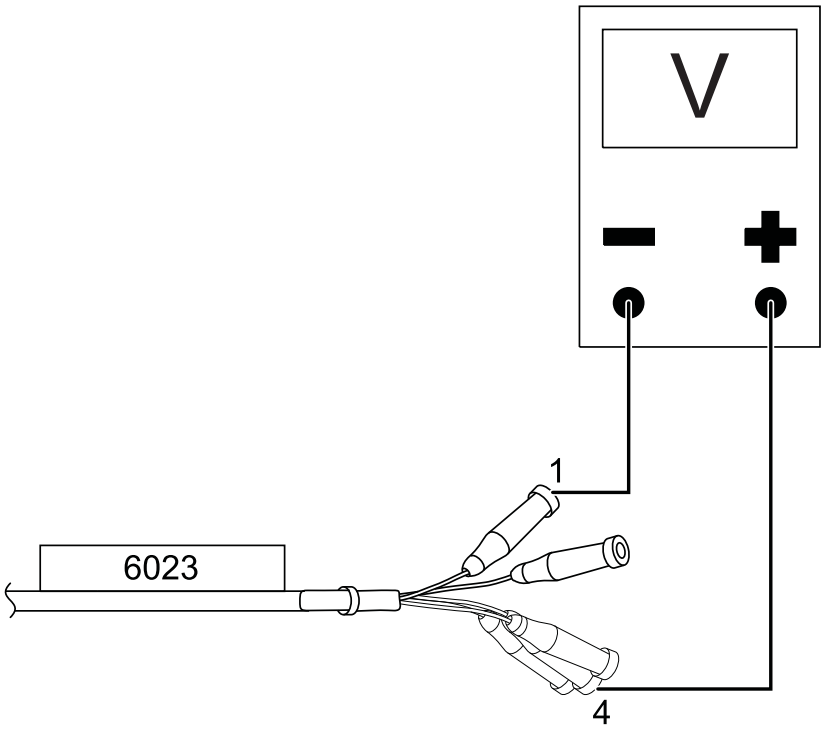


Figure 1011 Pin-Point Test 2

3. While EFP is energized, use Digital DMM to measure voltage between Breakout Harness ZTSE6023, pin-4, and pin-1. Record measurement.
4. Repeat steps 1–3 as necessary.

Expected Outcome

Voltage reading between pin-6 and pin-1 and voltage reading between pin-4 and pin-1 are within specifications.

Follow-On Procedure

None

Clean Fuel Source Test

Overview

This test verifies that the fuel supply system is not restricted and is working as designed. By replacing vehicle tank, lines, and chassis-mounted filter (if equipped), this test isolates the Electric Fuel Pump (EFP) by providing a clean unrestricted fuel source.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ Software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Clean Fuel Source Tool – 15–637–01
- Fuel Pressure Gauge – ZTSE4681
- Fuel Pressure Test Kit – ZTSE4657
- Fuel / Oil Pressure Test Coupler (Compucheck) – ZTSE4526

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO)
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log into ServiceMaxx™ software
4. Disconnect fuel inlet dry-break fitting from the fuel filter module.

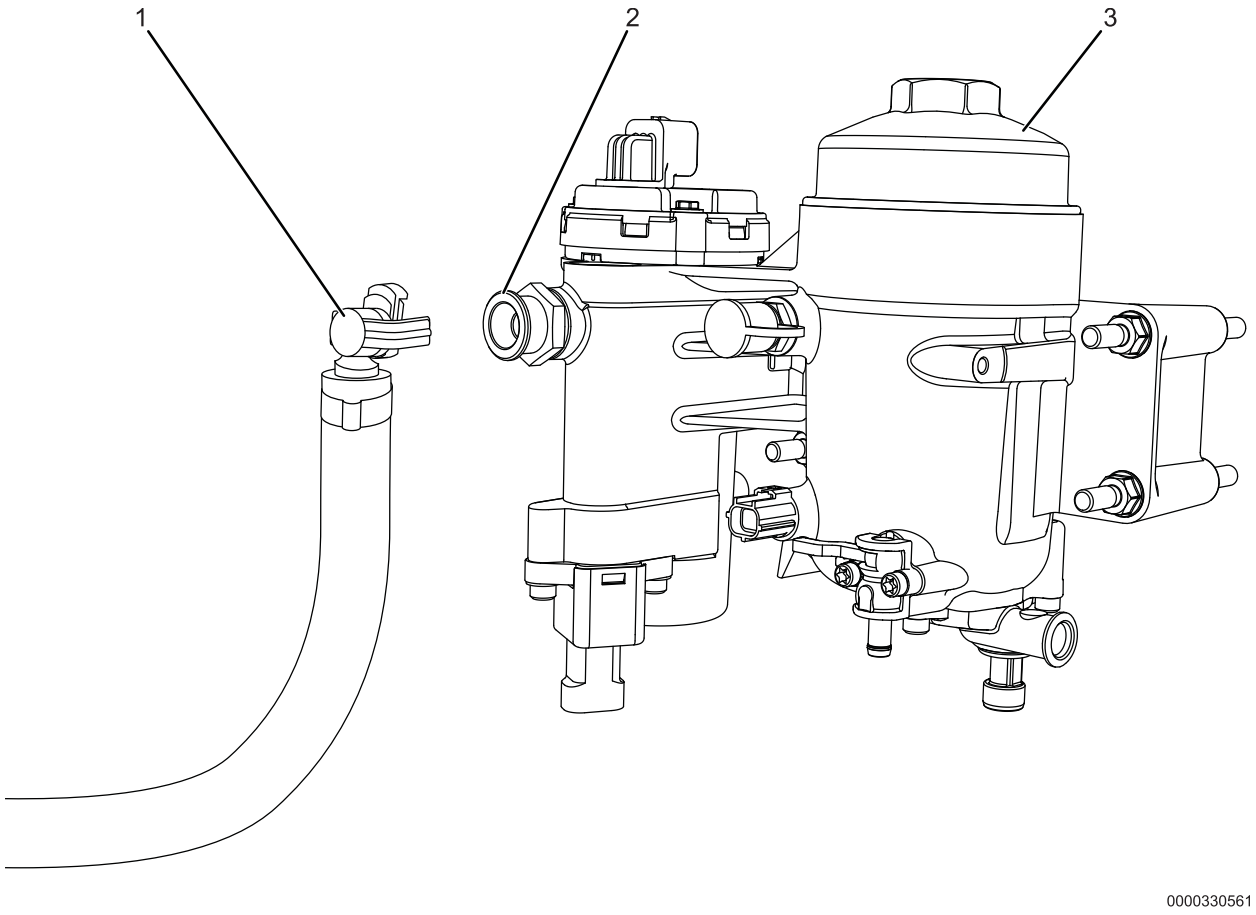


Figure 1012 Fuel Filter Module

1. Fuel Supply Line/Clean Fuel Source Dry Break Fitting
2. Fuel inlet
3. Fuel Filter Module

5. Connect Clean Fuel Source Tool 15-637-01 (item 1) to fuel inlet (item 2) of fuel filter module (item 3) (Figure 1012) and prime using primer bulb

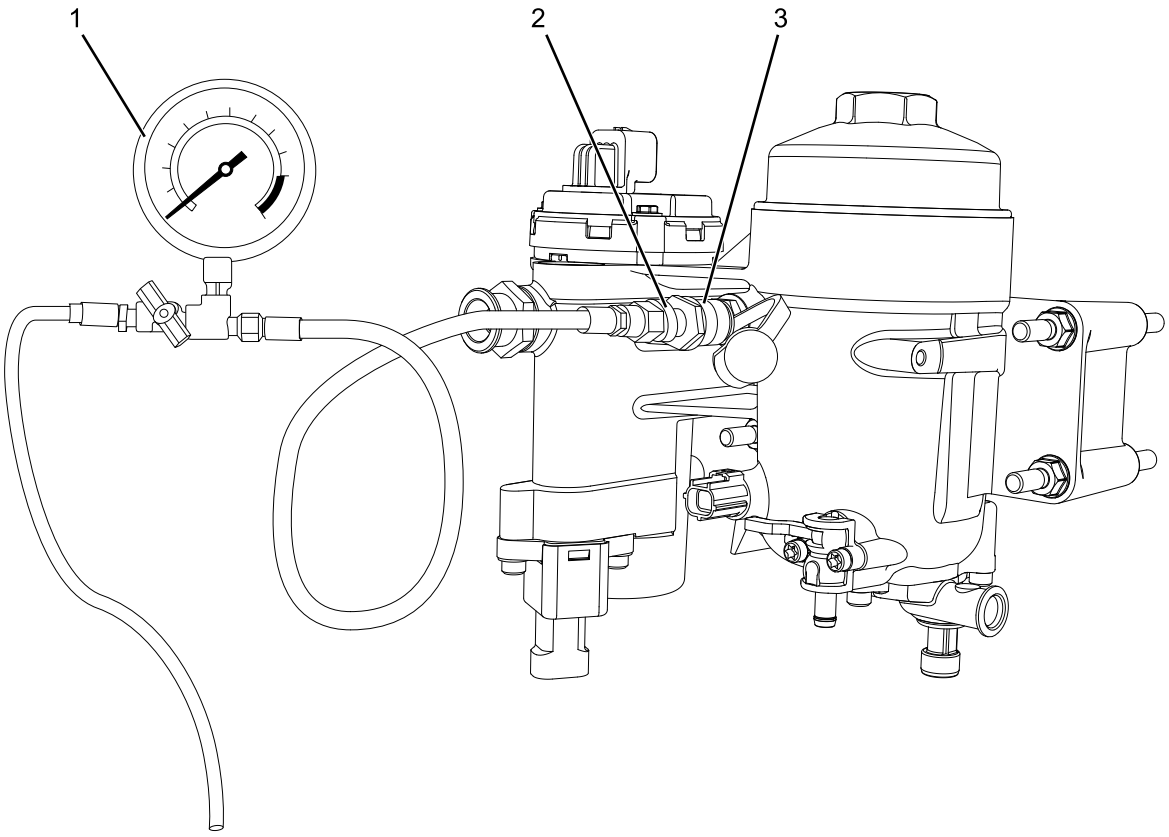


Figure 1013 Fuel Pressure Gauge to Fuel Filter Module Connection

1. Fuel Pressure Gauge ZTSE4681
2. Fuel Pressure Test Kit ZTSE4657
3. Fuel/Oil Pressure Test Coupler ZTSE4526

6. Connect Fuel Pressure Gauge ZTSE4681 (Figure 1013) (Item 1) to Fuel Filter Module test port using Fuel Pressure Test Kit ZTSE4657 (item 2) and Fuel/Oil Pressure Test Coupler ZTSE4526 (item 3).

Test Procedure

1. Perform Output State High Test (page 2145) to energize Electric Fuel Pump (EFP)..
2. Observe fuel pressure reading while pump is energized.
3. Activate fuel pump as many times as needed to record a consistent and accurate pressure reading.

Expected Outcome

Fuel pressure reading will be within specification (page 2404).

Follow-on Procedure

None

Intake Air Heater (IAH) Tests

Intake Air Heater (IAH) System Test

Overview

Verify operation of the Intake Air Heater (IAH) system. The IAH is commanded on by the Engine Control Module (ECM) when Engine Coolant Temperature (ECT) is below 30°F (-1°C). This test uses diagnostic software to command and monitor operation of the IAH system. This test can be performed without diagnostic software if coolant temperature is below specification.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™.

Test Procedure

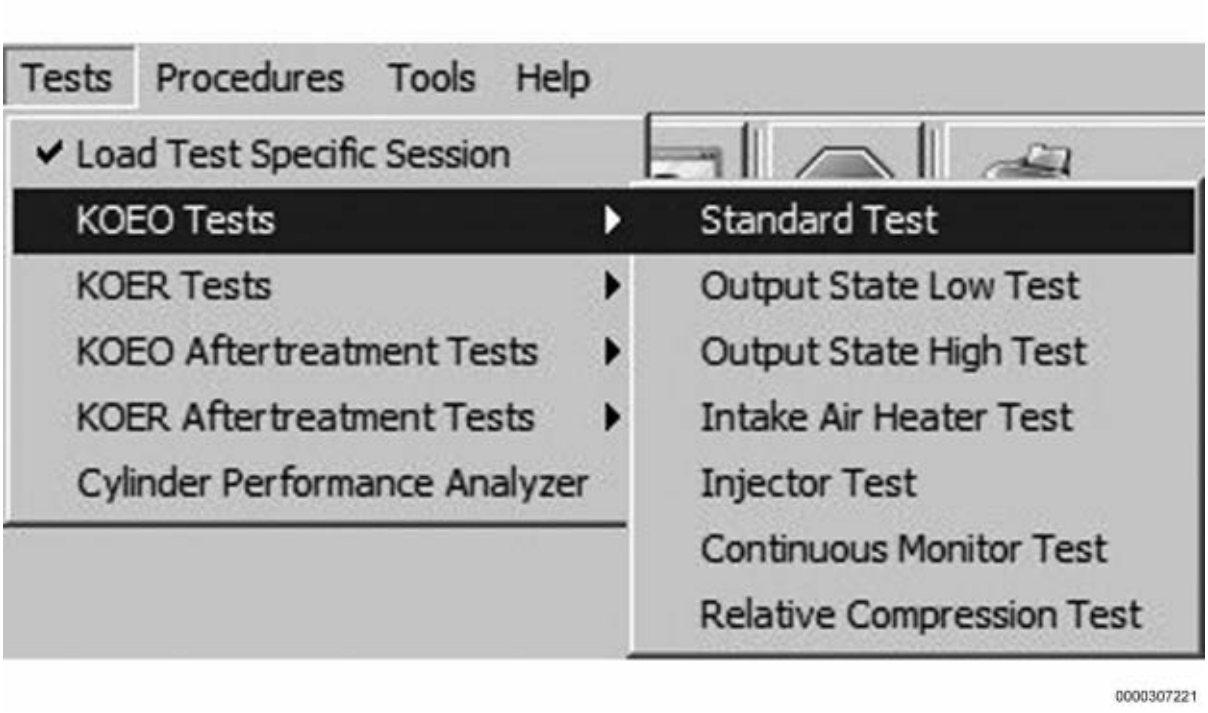


Figure 1014 KOEO Standard Test Drop Down Menu

1. Perform KOEO Standard Test (Figure 1014).
2. When test is complete, select Sessions > Hard Start – No Start.
3. Select Tests > KOEO Tests > Intake Air Heater Test.
4. Follow the on-screen instructions in ServiceMaxx™ software.
5. Crank engine over.
6. Monitor Air Intake Temperature (AIT).

Expected Outcome

Air Intake Temperature (AIT) will begin to rise when Intake Air Heater (IAH) system is on.

Follow-on Procedure

None

Intake Air Heater (IAH) Current Draw Test

Overview

Verify operation of Intake Air Heater (IAH) grid heating element. Using diagnostic software, digital multimeter (DMM) amp clamp, this test commands and monitors Intake Air Heater System operation. Intake Air Heater Test will command element on twice for 45 seconds.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

CAUTION: Performing multiple IAH Tests in ServiceMaxx™ will cause the element to overheat and damage it.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Digital Multimeter (DMM)
- Amp Clamp ZTSE4575

Equipment Condition

None

Test Setup

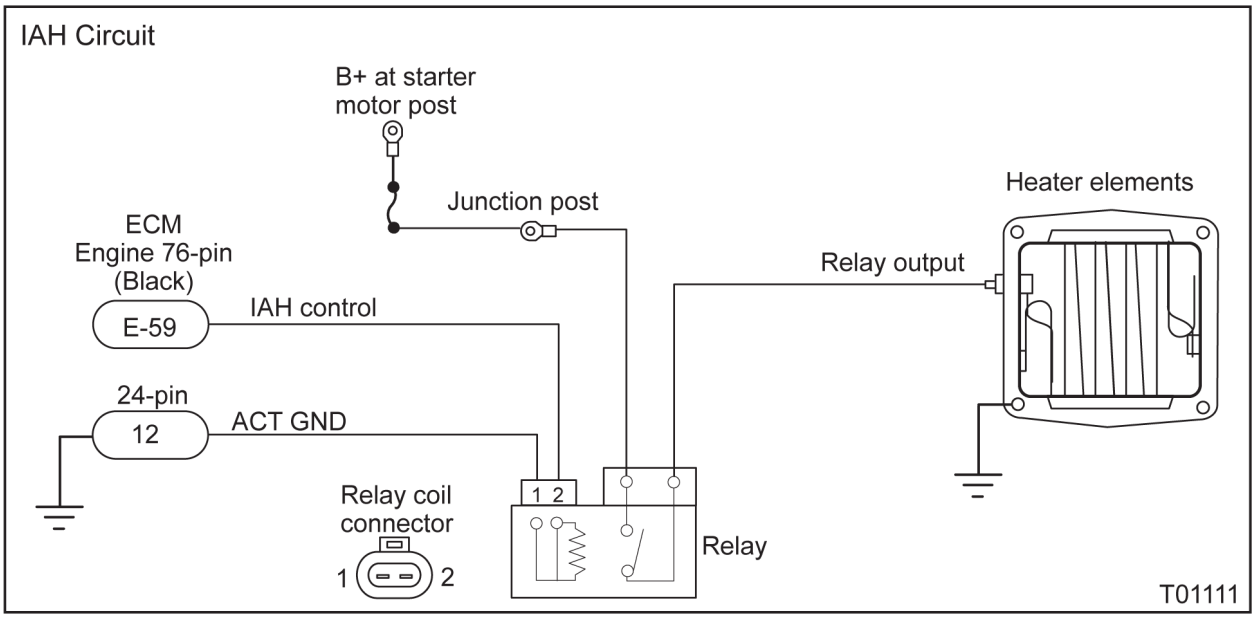


Figure 1015 IAH Circut

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

4. Amp Clamp connected to Digital Multimeter (DMM) and clamped onto relay output wire from IAH relay to IAH grid heating element.

Test Procedure

1. Perform Key On-Engine-Off (KOEO) Standard Test (page 2136).

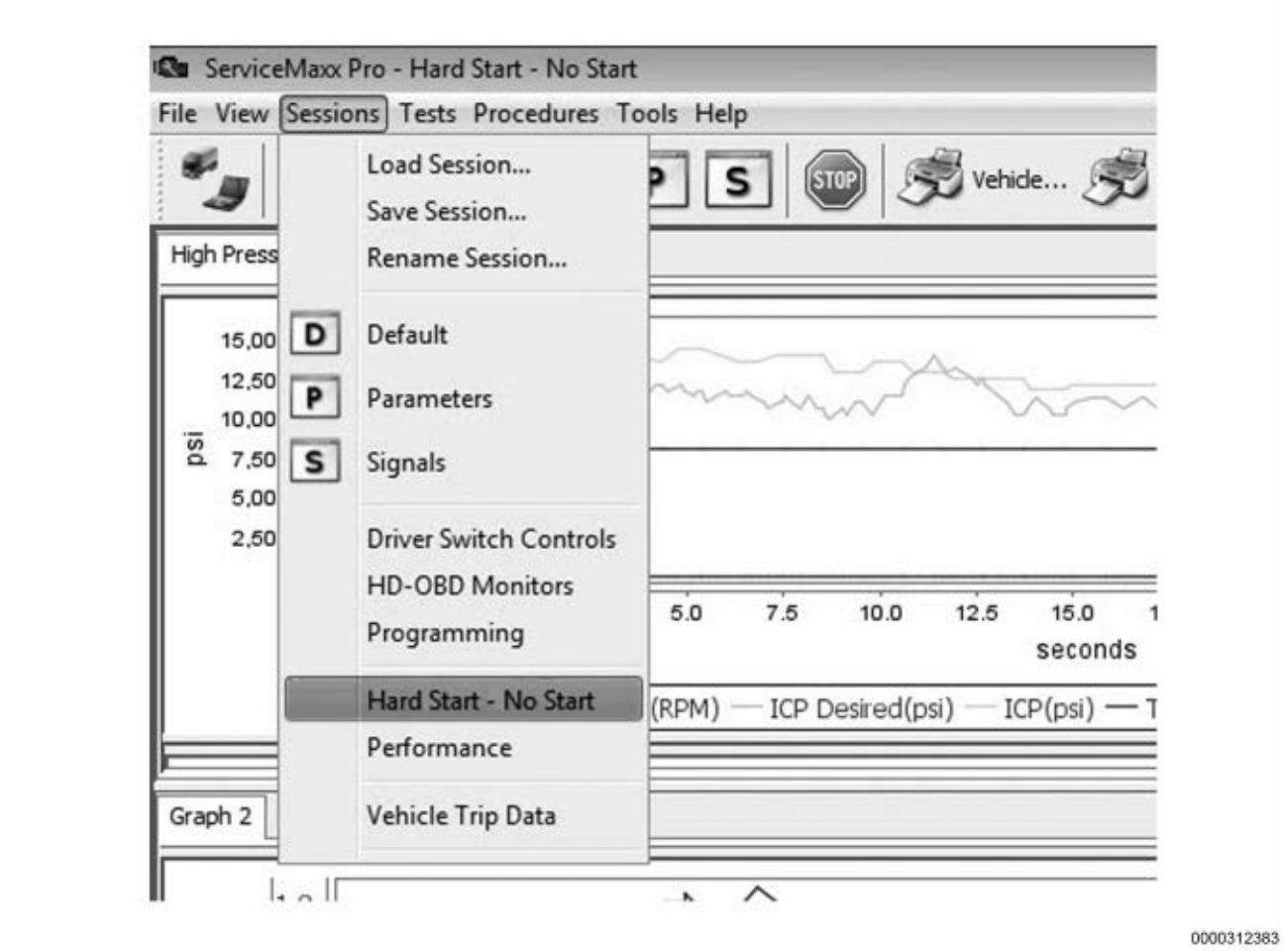


Figure 1017 Sessions Menu

2. When test is complete, select Sessions > Hard Start – No Start (Figure 1017).

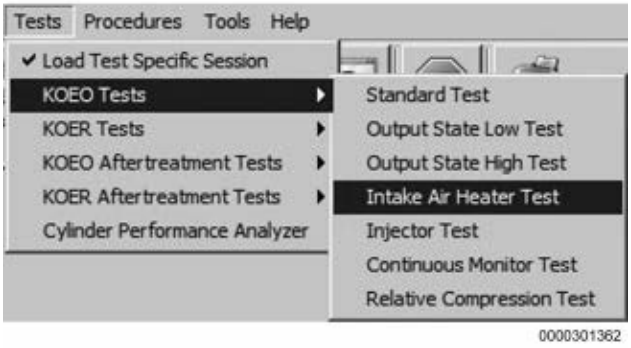


Figure 1018 ServiceMaxx™ Tests Menu

3. Select Tests > KOEO Tests > Intake Air Heater Test (Figure 1018).
4. Follow on-screen instructions in ServiceMaxx™ software.
5. Measure amperage draw with Digital Multimeter (DMM).

Expected Outcome

Current draw is within specification (125 Amps + / – 30 Amps within 2 seconds).

Intake Air Heater (IAH) Relay Test

Overview

The objective of this test is to determine if the Intake Air Heater (IAH) Relay is the source of an inoperative IAH system. A defective IAH Relay is found by measuring voltages on both sides of relay to validate its performance. All steps may not need to be performed. If any step condemns the relay, replace relay and retest.

CAUTION: Performing multiple IAH Tests with ServiceMaxx™ software will cause element to overheat. Overheating element will damage it.

Tools Required

- Electronic Service Tool with ServiceMaxx™ software
- Interface Cable (RP1210B-compliant supporting, J1939 and J1708)
- Digital Multimeter (DMM)
- Breakout Harness ZTSE6025

Equipment Condition

None

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
2. Log in to ServiceMaxx™ software.
3. Install Breakout Harness ZTSE6025 between Intake Air Heater (IAH) Relay and engine harness.

Test Procedure

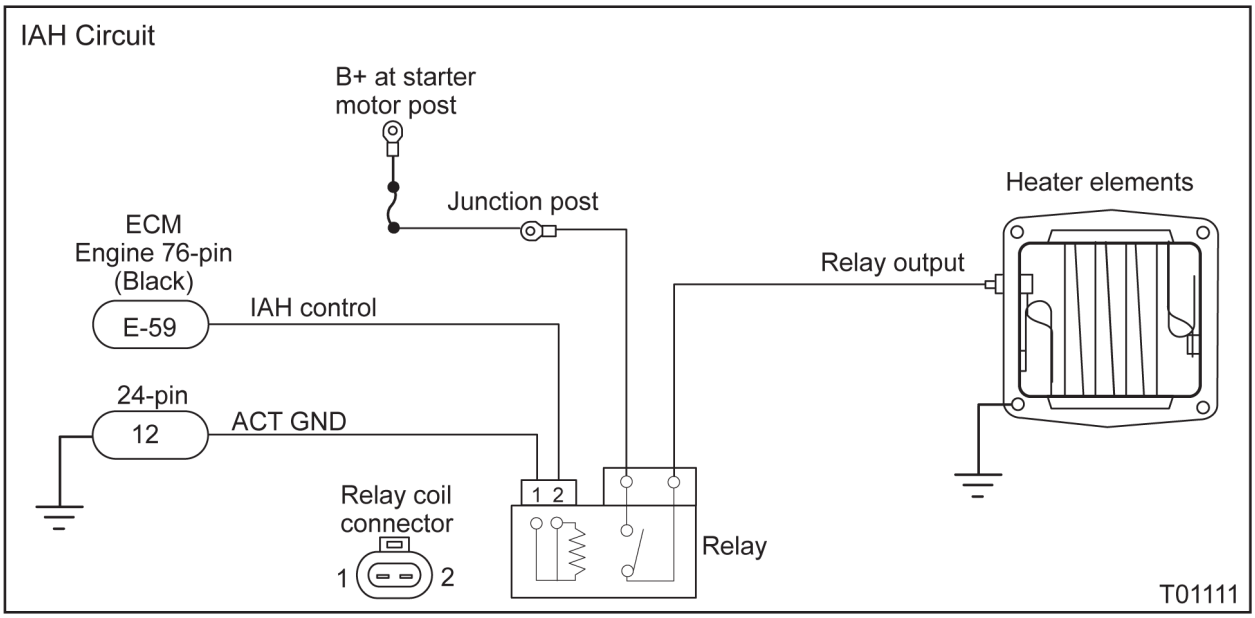


Figure 1019 Intake Air Heater (IAH) Circuit Diagram

1. Measure voltage on relay input side B+ to a known good ground. Is measurement approximately equal to B+?
   - Yes: Go to Step 2.
   - No: Check B+ circuit for open, corrosion, or blown fuse.
2. Perform Intake Air Heater (IAH) system test (page 2283). Measure voltage between relay output at heater element and a known good ground. Is voltage equal to B+ or equal to voltage reading taken in Step 1?
   - Yes: End diagnostic procedure.
   - No: Go to Step 3.
3. Perform Intake Air Heater (IAH) system test. Measure voltage between IAH Relay input terminal and IAH relay output terminal. Is voltage under 1 volt?
   - Yes: Go to Step 4.
   - No: Replace relay.
4. Perform Intake Air Heater (IAH) system test. Measure voltage between IAH Relay input terminal and a known good ground. Is voltage within 1 volt of B+?
   - Yes: Go to Step 5.
   - No: Check B+ circuit for poor connections.
5. Measure voltage between pin-1 and battery positive. Is voltage equal to B+?
   - Yes: Go to Step 4.
   - No: Check for an open between relay coil connector pin-1 and ground.

6. Perform Intake Air Heater (IAH) system test (page 2283). Measure voltage between relay coil connector pin-1 and pin-2. Is voltage equal to B+?
   - Yes: End diagnostic procedure.
   - No: Go to diagnostics for SPN 729 FMI 5 (page 1279).

Expected Outcome

There will be power and ground to coil side of relay when Intake Air Heater Test (IAH) is run. There will also be constant power to input side of relay. That power will transfer to output terminal for heating element when control circuit is commanded on.

Follow-On Procedure

None

High-Pressure Charge Air Cooler (HPCAC) Pressure Test

Overview

This test verifies the High-Pressure Charge Air Cooler's (HPCAC) internal integrity by using compressed air to check for defects and leaks.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

WARNING: To prevent personal injury or death, keep hoses and mating surfaces clear of oil and grease.

Tools Required

- 09–925–01 Cleaning Adapter Kit with Charge Air Cooler Pressure Test Kit – (ZTSE4341)
- Spray bottle with soapy water

Equipment Condition

High-Pressure Charge Air Cooler (HPCAC) is removed from truck.

Test Setup



Figure 1020 CAC Cleaning Adapter Kit (Off Chassis) 09–925–01 With CAC Pressure Test Kit ZTSE4341 Included

1. CAC Pressure Test Kit ZTSE4341

1. Install Charge Air Cooler Pressure Test Kit to HPCAC.
2. Adjust air regulator valve to lowest setting.
3. Attach shop air to valve on gauge / regulator assembly.

Test Procedure

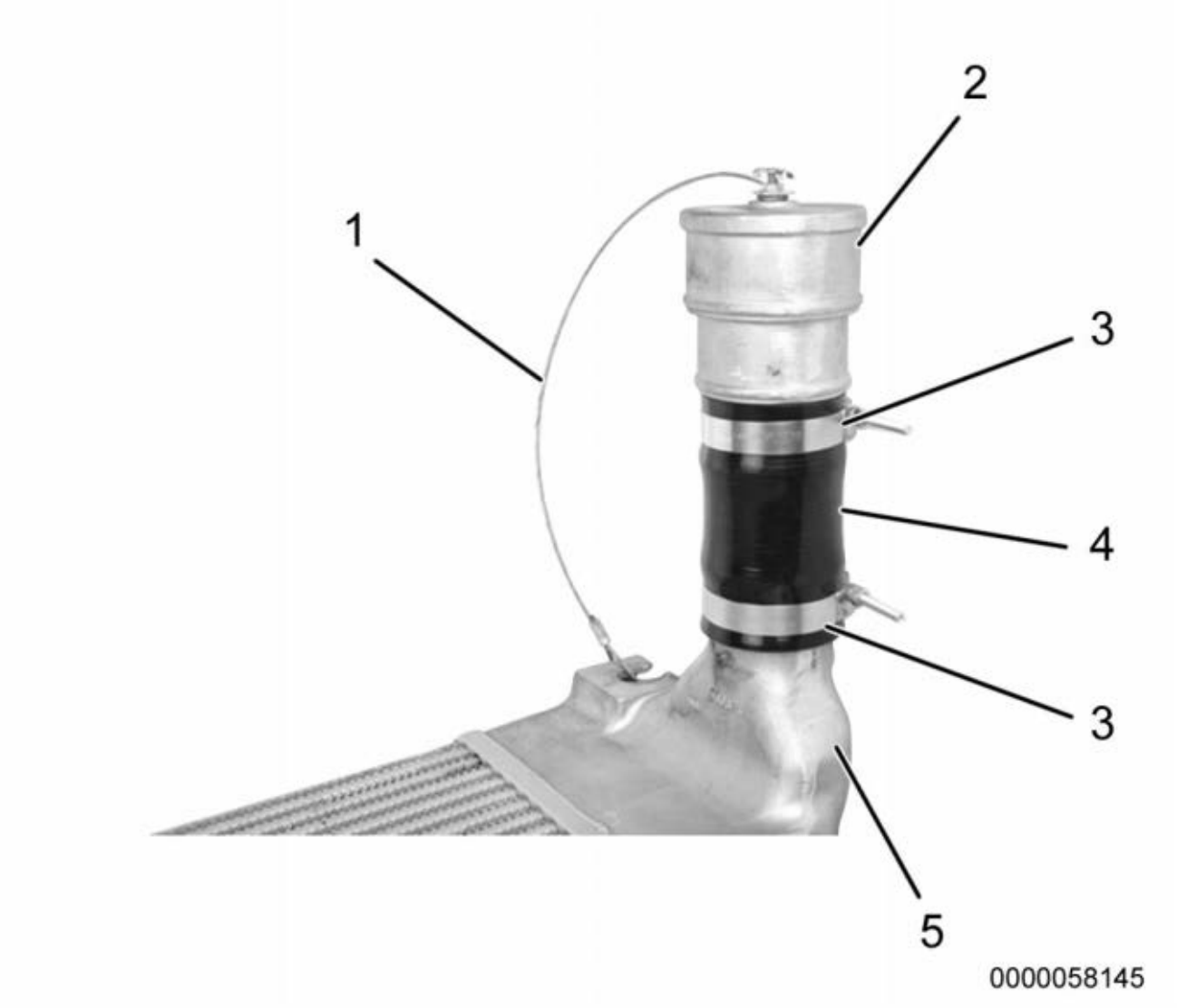


Figure 1021 Bleed-Off Coupler Installed On HPCAC Inlet

1. Safety cable
2. Bleed-off coupler
3. T-clamp (2)
4. Small hose
5. High-Pressure Charge Air Cooler (HPCAC) Inlet

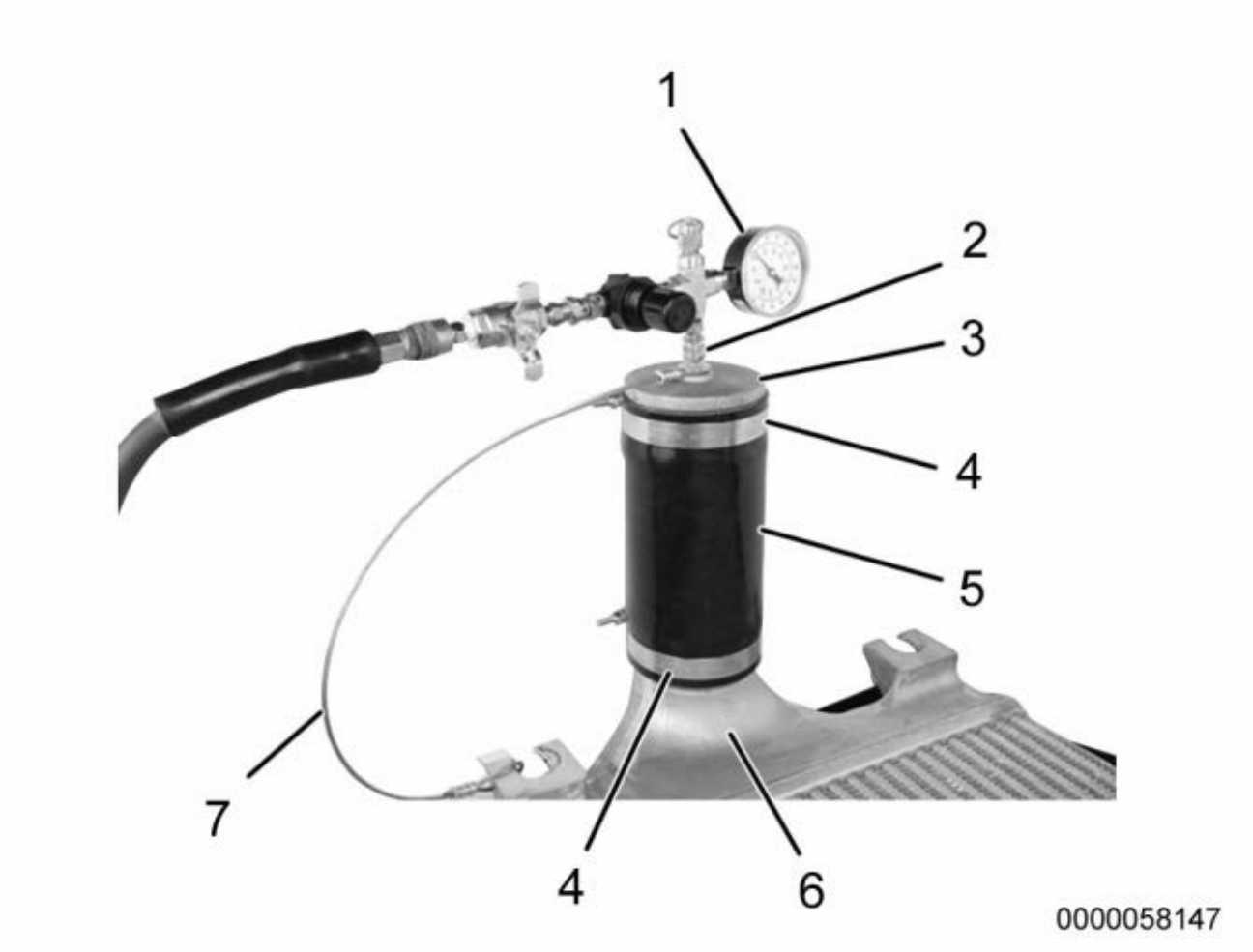


Figure 1022 CAC Pressure Test Kit Installed on HPCAC Outlet

1. Gauge / regulator assembly
2. Quick disconnect fitting
3. Gauge coupler
4. T-clamp (2)
5. Large hose
6. High-Pressure Charge Air Cooler (HPCAC) Outlet
7. Safety cable

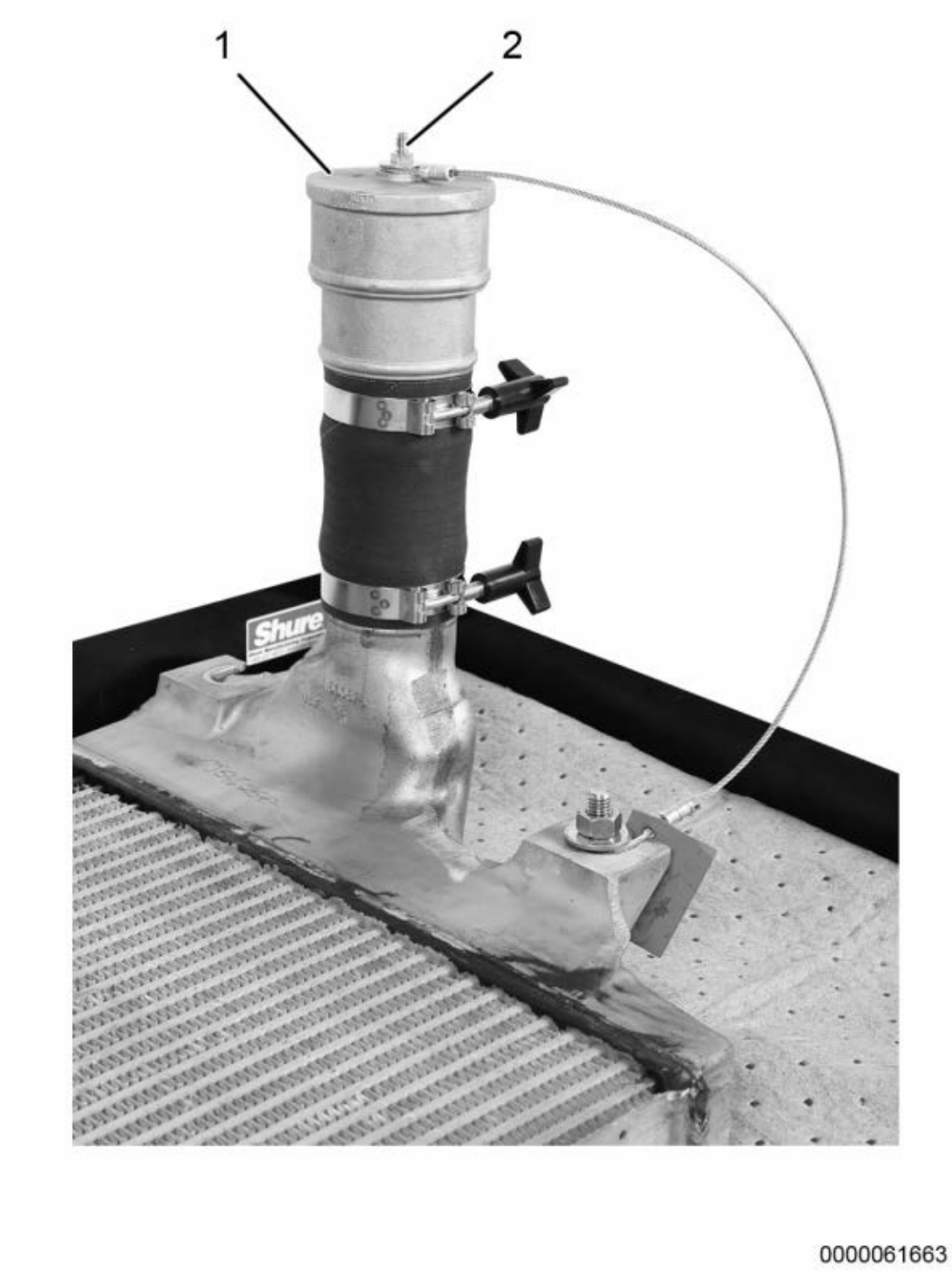


Figure 1023 Bleed-off Coupler Components

1. Bleed-off coupler
2. Bleed-off valve

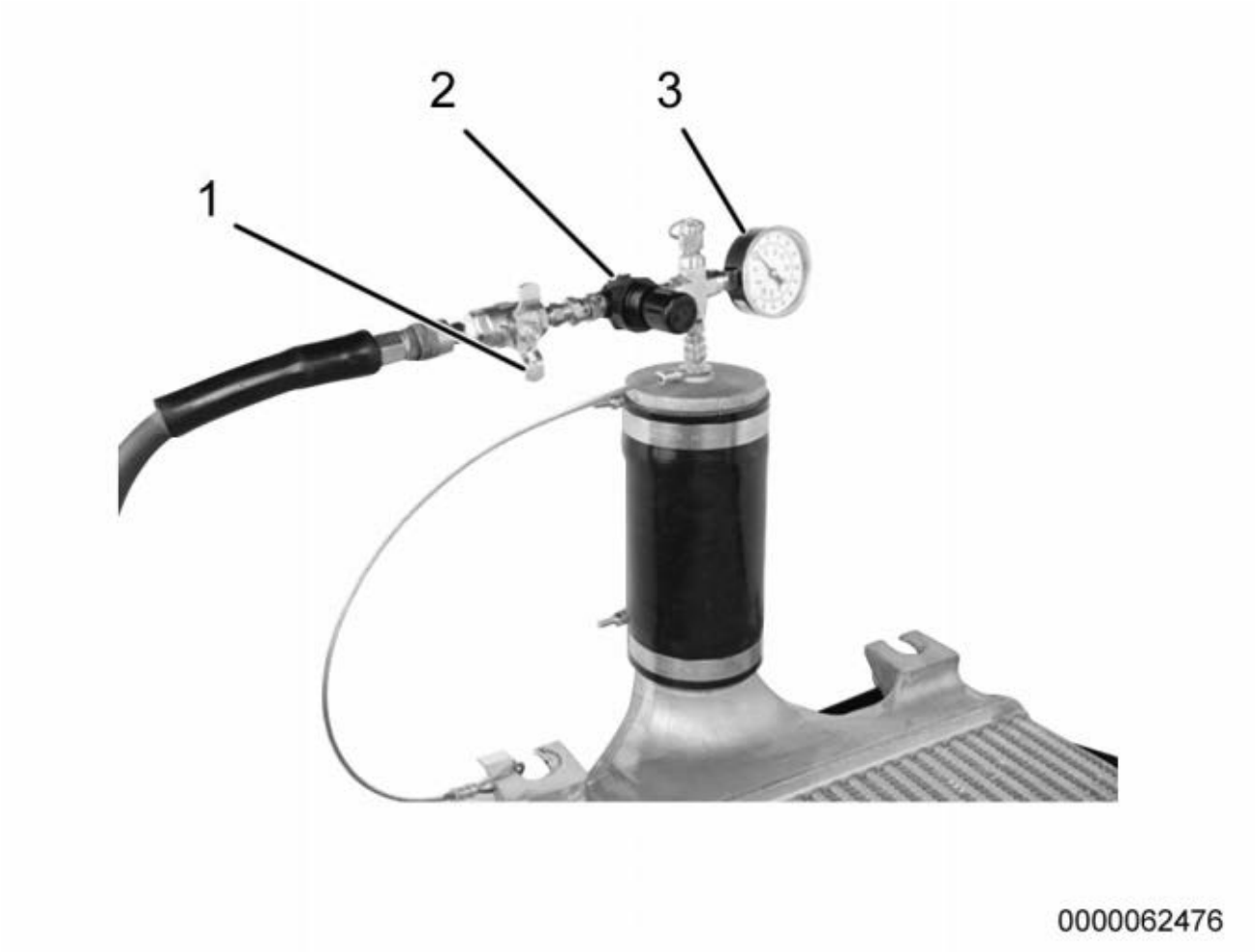


Figure 1024 Gauge / Regulator Assembly Connections

1. Air Valve
2. Air Regulator Knob
3. Gauge

WARNING: To prevent personal injury or death, attach safety cables to High-Pressure Charge Air Cooler (HPCAC) or a known good anchor point.

CAUTION: Adjust air regulator valve to minimum setting before connecting shop air supply. Accidentally applying high-pressure can damage tool components or HPCAC.

1. Open air valve slightly, slowly increasing to 30 psi (206.8 kPa).
2. Close air valve and monitor gauge reading for 15 seconds.
   - Reading should not drop more than 5 psi.
   - If reading falls more than 5 psi (34 kPa), spray connections and High-Pressure Charge Air Cooler (HPCAC) with soapy water to determine point of leak (air bubbles should appear).
3. Repeat steps 1 and 2 three times to verify reading.

4. Open bleed-off valve slowly to release compressed air.

Expected Outcome

High-Pressure Charge Air Cooler (HPCAC) will hold air pressure.

Follow-On Procedure

None

Interstage Cooler (ISC) Pressure Test

Overview

This test verifies the internal integrity of the Interstage Cooler (ISC) by using compressed air to check for defects and leaks. This test also ensures no coolant leakage-to-intake, or charge air-to-coolant leak can occur.

WARNING: To prevent personal injury or death, tighten pressure test kit properly prior to testing.

WARNING: To prevent personal injury or death, keep mating surfaces and hoses clear of oil and grease.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

CAUTION: To avoid damage to equipment, limit the amount of pressure used in this test to 30 psi.

Tools Required

- Air pressure regulator
- Interstage Cooler Test Kit (Test Kit being developed)
- Spray bottle with soapy water

Equipment Condition

ISC removed from truck.

Test Setup

GRAPHIC
PLACE
HOLDER

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GRAPHIC
PLACE
HOLDER

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1. Attach ISC Test Kit to Interstage Cooler (ISC).
   - Obtain 3-inch couplers and clamps locally.
2. Cover ISC air outlet with Air Outlet Disc Plug ((Figure 1027)).
3. Install Air Outlet Disc Plug Retaining Bracket ((Figure 1027)) on top of Air Outlet Disc Plug and tighten clamping bolt to seal ISC air outlet ((Figure 1026)).
4. Attach Air Intake Plug ((Figure 1027)) to ISC air intake ((Figure 1026)), and tighten clamps.
5. Attach Coolant Port Plug ((Figure 1027)) to ISC coolant return port ((Figure 1026)) and tighten clamp.
6. Attach Coolant Port Plug ((Figure 1027)) to ISC coolant supply port ((Figure 1026)) and tighten clamp.

Test Procedure

GRAPHIC
PLACE
HOLDER

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1. Connect air pressure regulator to air intake side ((Figure 1027)) of ISC and pressurize to 30 psi (207 kPa).
2. Spray a soapy water solution on ISC. Look for leaks from hose connections, ISC, or test components.
   - If a leak is detected on ISC or if test gauge pressure drops, replace ISC.
3. Connect regulator with shop air source and pressurize the coolant supply port ((Figure 1027)) of ISC to 30 psi (207 kPa).
4. Spray a soapy water solution on ISC. Look for leaks from hose connections, ISC, or test components
   - If a leak is detected on ISC or if test gauge pressure drops, replace ISC.

Expected Outcome

No signs of leaks will be detected and the pressure gauge will remain steady on both the air and coolant sides of the Interstage Cooler (ISC).

Follow-On Procedure

None

Crankcase Pressure Test

Overview

This test verifies that crankcase pressure is within specification while isolating worn or damaged parts.

WARNING: To prevent personal injury or death, when routing test line, do not crimp line, run line too close to moving parts, or let line touch hot engine. Secure the Manometer and test line to not obstruct vehicle operation.

Tools Required

- Crankcase Pressure Test Tool ZTSE4039
- Digital Manometer ZTSE2217
- Slack Tube® Manometer ZTSE2217A
- Standard shop bolt (to plug intake tube)

Equipment Condition

Remove any necessary truck-mounted components to access oil breather tubes and install test equipment.

Test Setup

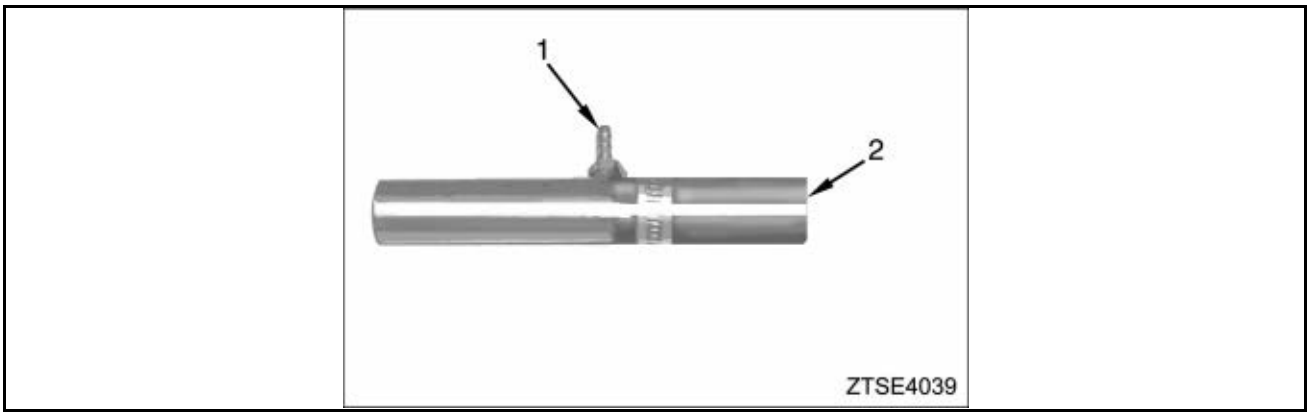


Figure 1028 ZTSE4039 (0.406 in. diameter)

1. To magnehelic gauge or manometer
2. To valve cover



Figure 1029 Digital Manometer

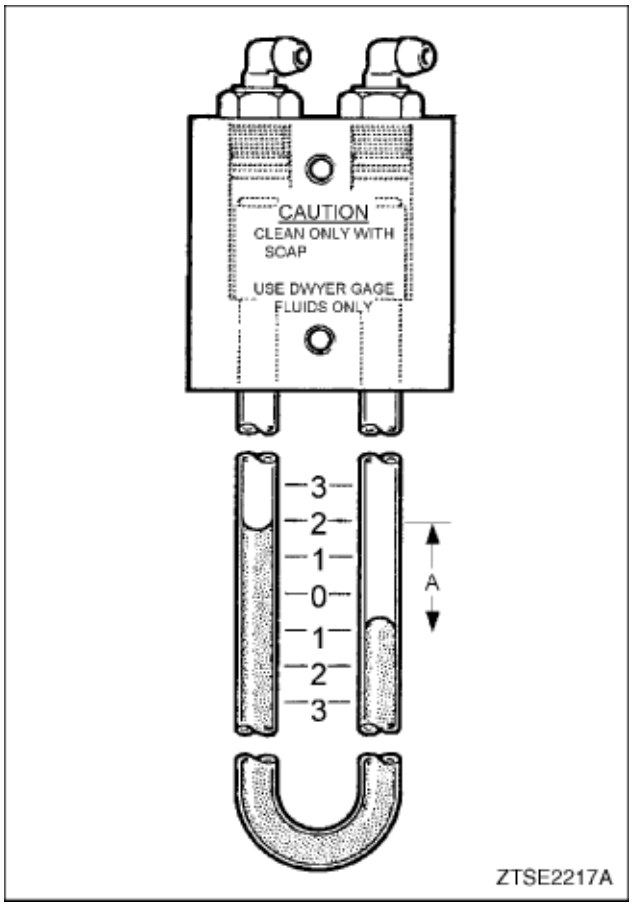


Figure 1030 Slack Tube® Manometer (ZTSE2217A)

1. Perform Crankcase Oil Breather Separator Test.

NOTE: Ensure engine Coolant Temperature (ECT) is at or above 158°F (70°C).

2. Turn engine OFF.

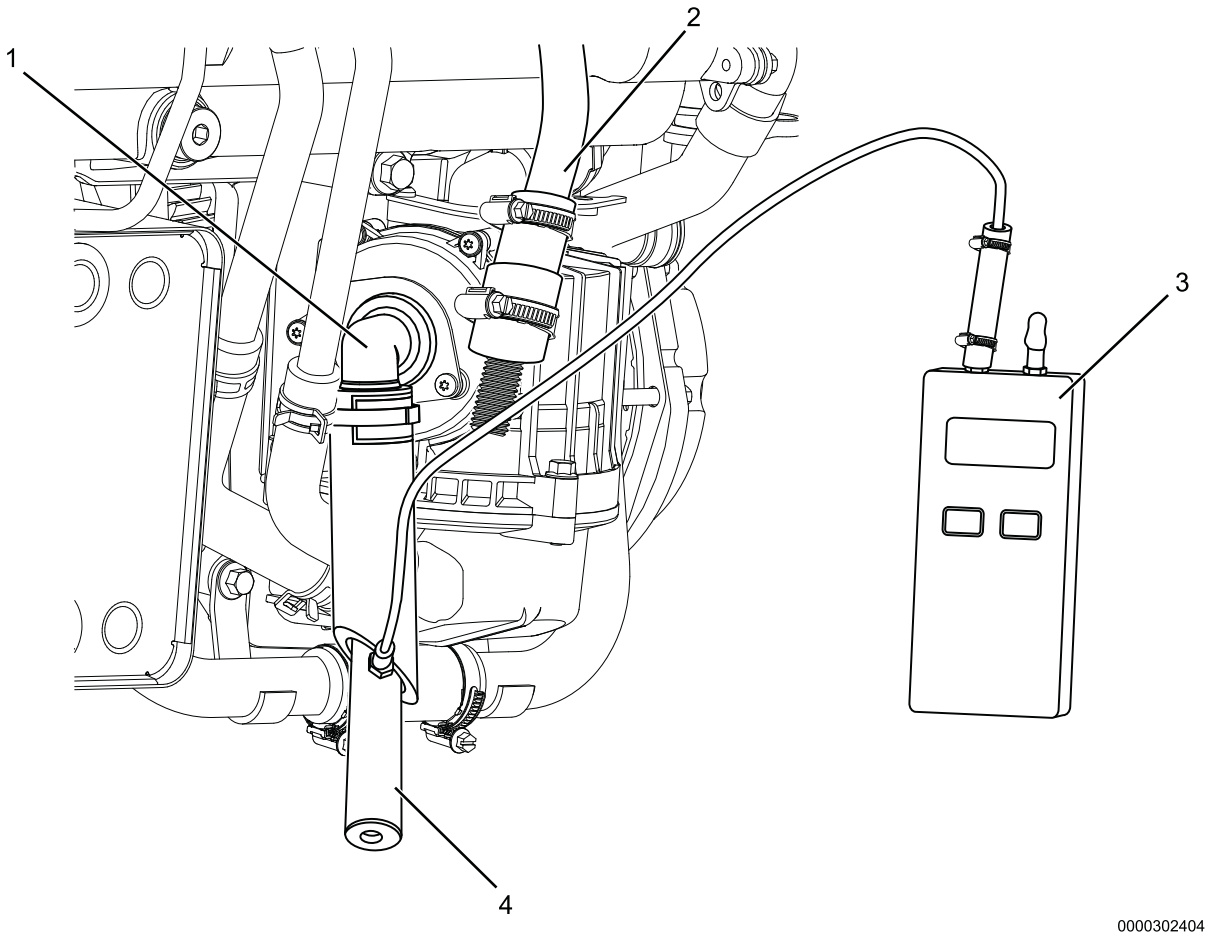


Figure 1031 Crankcase Pressure Test Adapter Installed

1. Breather elbow
2. Crankcase breather outlet tube
3. Digital Manometer
4. Crankcase Pressure Test Tool

3. Disconnect breather outlet tube from breather elbow.
4. Plug tube to prevent dirt ingestion.
5. Install crankcase pressure test adapter on breather outlet tube.
6. Install manometer to crankcase pressure test adapter.

Test Procedure

1. Start engine.
2. Press accelerator pedal to the floor and hold. While pedal is pressed to the floor, allow manometer reading to stabilize then record pressure reading.
3. Turn engine OFF.
4. If engine has an air compressor, disconnect the compressor discharge line and repeat steps 1 through 4.

Expected Outcome

Engine crankcase pressure(s) will be within specification.

Follow-on Procedure

None

General Test Procedures

Coolant Heater Assembly Test

Overview

Verify operation of the Engine Coolant Heater.

WARNING: To prevent serious personal injury or death due to electric shock from 120 Volts Alternating Current (VAC), ensure conditions are appropriate and certified protective apparel is worn.

Tools Required

- Digital Multimeter (DMM)

Equipment Condition

None

Test Setup

1. Engine must be cold to perform this test.

Test Procedure

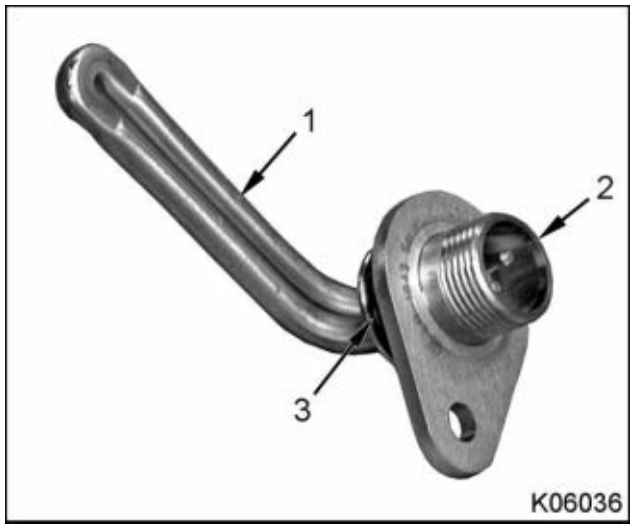
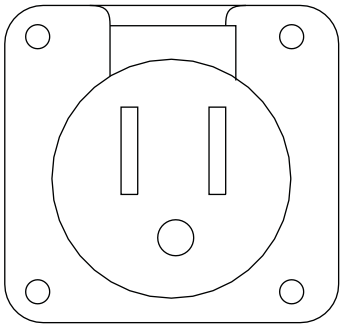


Figure 1032 Engine Coolant Heater

1. Heater element
2. Cord adapter
3. O-ring



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Figure 1033 External Plug Shown with Lid Removed for Clarity

1. Measure resistance at external plug for Oil Pan / Coolant Heater.
   - Reading should be approximately 12 ohms. If unit is equipped with both Coolant and Oil Pan Heater, they are wired on the same plug and the reading should be approximately 8.5 ohms. If reading is within specifications, go to step 3.
   - If reading is not within specifications, go to step 2.
2. Disconnect cord from coolant heater on the left side of the engine block and take resistance reading at the terminals on the heater itself. See information below for further direction.
   - If the reading is approximately 12 ohms, the cord needs to be replaced.
   - If the reading is not approximately 12 ohms, install cord and go to step 3.
3. Connect standard extension cord between wall outlet and truck-mounted plug (Figure 1033).
4. Wait 2 to 3 minutes, and then check to see if coolant heater is heating up by feeling cord adapter.

Expected Outcome

Resistance checks will be within specification and coolant heater will heat when plugged in.

Follow-On Procedure

None

Oil Pan Heater Test

Overview

Verify operation of the Engine Oil Pan Heater.

WARNING: To prevent serious personal injury or death due to electric shock from 120 Volts Alternating Current (VAC), ensure conditions are appropriate and certified protective apparel is worn.

Tools Required

- Digital Multimeter (DMM)

Equipment Condition

None

Test Setup

1. Ensure engine is cold prior to performing this test.

Test Procedure

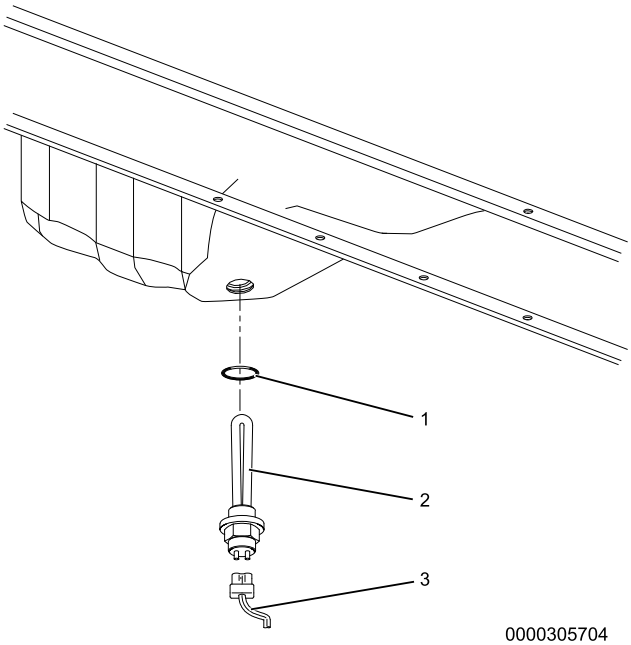
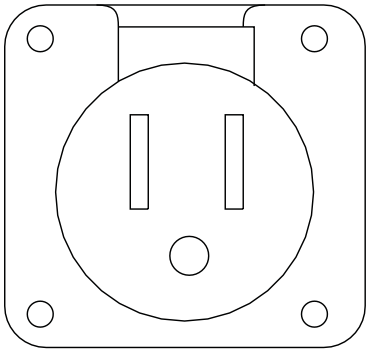


Figure 1034 Oil Pan Heater

1. O-ring
2. Oil heater element
3. AC power cord



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Figure 1035 Oil Pan Heater Plug (Shown with Cover Removed for Clarity)

1. Measure resistance at external plug for Oil Pan / Coolant Heater (Figure 1035).
   - Reading should be approximately 12 ohms. If unit is equipped with both a Coolant and Oil Pan Heater, they are wired on the same plug and reading should be approximately 8.5 ohms. If reading is within specifications, go to step 3.
   - If reading is not within specifications, go to step 2.
2. Disconnect cord from Oil Pan Heater (Figure 1034) on left side of engine oil pan. Measure resistance at terminals on heater itself.
   - If reading is approximately 12 ohms, cord needs to be replaced.
   - If reading is not approximately 12 ohms, install cord and go to step 3.
3. Connect standard extension cord between wall outlet and truck-mounted plug (Figure 1035).
4. Wait 2 to 3 minutes, and check to see if Engine Oil Pan Heater (Figure 1034) is heating up by feeling the area where cord attaches.

Expected Outcome

Resistance checks will be within specification and Oil Pan Heater will heat when plugged in.

Follow-On Procedure

None

Coolant Test Procedures

Deaeration Tank Cap Test

Overview

Verify proper operation of the deaeration tank cap.

WARNING: To avoid possible injury or death, use care when working around hot coolant.

WARNING: To prevent personal injury or death, do the following when removing the radiator cap or deaeration cap:

- **Allow engine to cool for 15 minutes.**
- **Wrap a thick cloth around radiator cap or deaeration cap.**
- **Loosen cap slowly a quarter to half turn counterclockwise to vent pressure.**
- **Pause for a moment to avoid being scalded by steam.**
- **Continue to turn the cap counterclockwise to remove.**

Tools Required

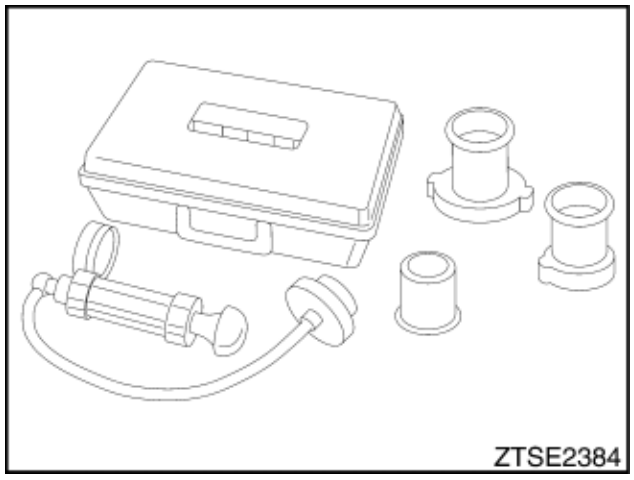


Figure 1036 ZTSE2384 Radiator Pressure Testing Kit



Figure 1037 09–040–01 Coolant Cap Pressure Tester

- ZTSE2384 Radiator Pressure Testing Kit or 09–040–01 Coolant Cap Pressure Tester

Equipment Condition

None

Test Setup

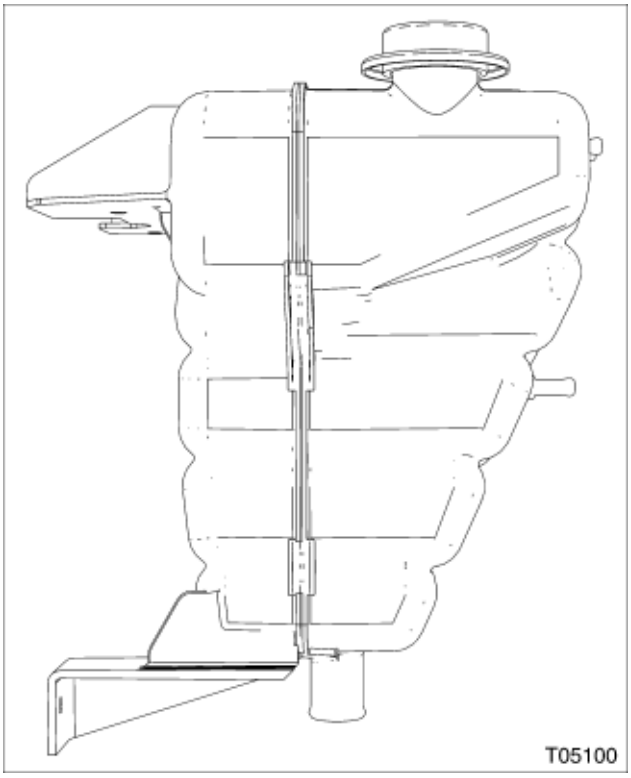


Figure 1038 Deaeration Tank and Cap

1. Remove cap from deaeration tank (Figure 1038).
2. Check deaeration tank neck (Figure 1038) for cracks and warping.

Test Procedure

1. Determine rated pressure of deaeration tank cap.
2. Test dearation cap following the tool instructions for the tester being used.
3. Replace cap if not within specification.

Expected Outcome

Cap will hold rated pressure.

Follow-on Procedure

None

Cooling System Pressure Test

Overview

The following test is used to verify integrity of cooling system by using air pressure. Applying air pressure ensures system has no leaks. The system should hold pressure indicating there are no leaks in the system.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

WARNING: To prevent personal injury or death, do following when removing radiator cap or deaeration cap:

- **Allow engine to cool for 15 minutes or more.**
- **Wrap a thick cloth around the radiator cap or deaeration cap.**
- **Loosen cap slowly a quarter to half turn to vent pressure.**
- **Pause for a moment to avoid being scalded by steam.**
- **Continue to turn cap counter-clockwise to remove.**

WARNING: To prevent personal injury or death, ensure shop-air pressure is properly regulated.

Tools Required

- Coolant Management Tool KL5007NAV.

Equipment Condition

1. Remove splash guards (as necessary).
2. Cooling system full.

Test Setup

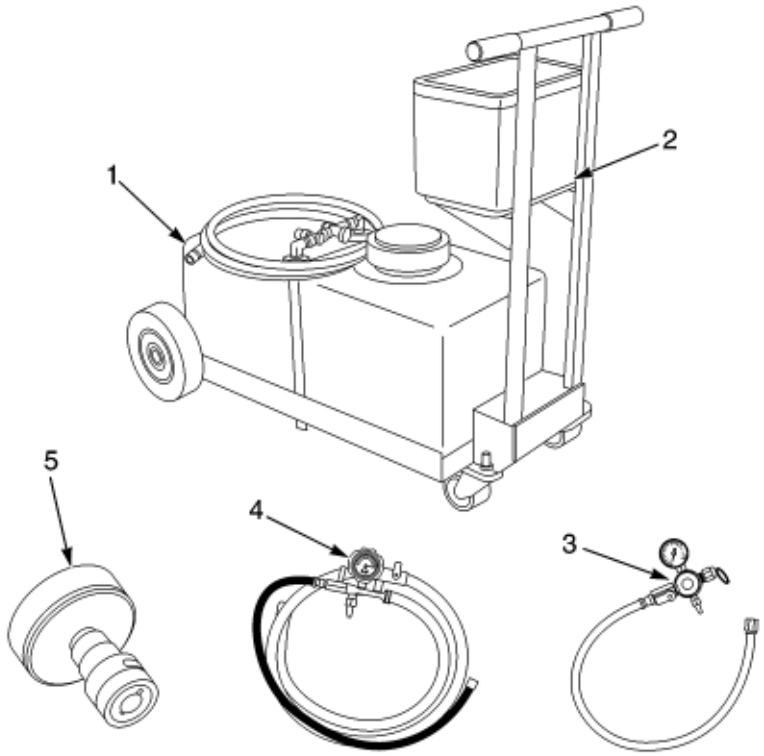


Figure 1039 Coolant Management Tool (KL5007NAV)

1. Coolant Supply Tank
2. Cart
3. Pressure Module
4. Vacuum Module
5. Cap Adapter

1. Replace deaeration cap with cap adapter (Figure 1039) (Item 5) from Coolant Management Tool.
2. Connect Pressure Module (Figure 1039) (Item 3) to cap adapter (Figure 1039) (Item 5).
3. Apply shop air to Pressure Module (Figure 1039) (Item 3).

Test Procedure

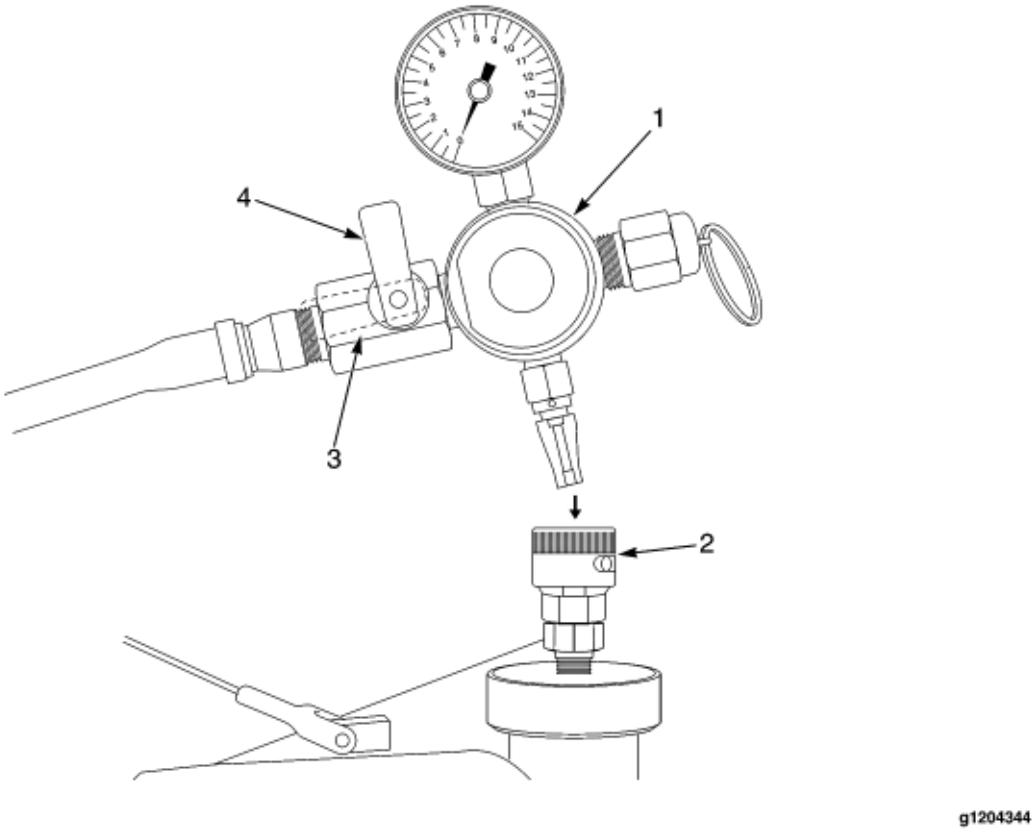


Figure 1040 Cap Adapter and Pressure Module

1. Pressure Module
2. Cap Adapter (KL5004NAV)
3. Air Valve (Open)
4. Air Valve (Closed)

1. Turn coolant supply tank (Figure 1039) (Item 1) to CLOSED position.
2. Open air valve (Figure 1040) (Item 3) on Pressure Module (Figure 1040) (Item 1) making sure not to exceed cap pressure on system.
3. Close air valve (Figure 1040) (Item 4). System is now pressurized with air.
4. Take note of gauge reading and check for pressure decay. If no decay is detected, there are no leaks, go to Step 7.
5. If decay is evident, check cooling system for leak(s).
6. Repeat steps 1 to 3 to re-pressurize system as necessary to find source of pressure loss.
7. Disconnect compressed air, and remove pressure module (Figure 1040) (Item 1).
8. Slowly open air valve (Figure 1040) (Item 3) on pressure module to vent the pressure in the cooling system.

Expected Outcome

Engine cooling system holds steady air pressure.

Follow-on Procedure

Replace splash guards (if removed).

Coolant Over-Flow / Over-Temperature Test

Overview

This test is to determine if cooling system over heats or forces coolant out of overflow tube on deaeration tank.

⚠ WARNING: To prevent personal injury or death, be aware of hot coolant being expelled from the deaeration tank during this test.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software (ServiceMaxx™ Connection and Data Recording, page 2096).

Test Procedure

1. Use ServiceMaxx™ software to view Engine Coolant Temperature 1 (ECT1).
2. Start and run engine until it reaches normal operating temperature.
3. Raise engine speed to high idle. Check for coolant overflowing from deaeration tank.
4. Run engine temperature above 225°F (107°C) and radiator intake temperature above 200°F (93°C).
5. Monitor ECT1 and note if temperature exceeds normal operating temperature. Check for coolant overflowing out of deaeration tank overflow hose.

Expected Outcome

Coolant will not exceed normal operating temperature and coolant will not be expelled from overflow hose on deaeration tank.

Follow-On Procedure

None

Thermostat Operational Test

Overview

Determine if engine thermostat opens when engine reaches operating temperature by monitoring upper radiator hose temperature.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Infrared Thermometer ZTSE4799

Equipment Condition

1. Allow engine to cold soak.
2. Perform Coolant Level Inspection (page 2355).

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124) and log in.
3. Check for active or inactive fault codes related to coolant temperature. If present, diagnose and repair these faults.

Test Procedure

1. Using ServiceMaxx™ software, select > Sessions > Default > Temperature.
2. After engine is cold soaked, verify following sensor signals are approximately equal. If not, diagnose and repair sensor or circuit problem.
   - Engine Coolant Temperature 1 (ECT1)
   - Engine Oil Temperature (EOT)
   - Exhaust Gas Temperature (EGT)
   - Intake Manifold Temperature (IMT)
3. Start engine.
4. Monitor upper radiator hose temperature using Infrared Thermometer.
5. Run engine to operating temperature. Upper radiator hose temperature should be less than ECT1 while thermostat is closed. As ECT1 reaches approximately 190°F (88°C), a working thermostat will begin to open, and the upper radiator hose should heat up.

Does upper radiator hose temperature increase to ECT1 ±5°F after engine warms up past thermostat opening temperature specification?

- No, ECT1 value continues to rise and upper radiator hose remains cooler. Replace thermostat and retest.
- No, ECT1 never reaches 190°F (88°C). Replace thermostat and retest.
- Yes, thermostat is working properly.

Expected Outcome

Upper radiator hose temperature will increase to within ±5°F of ECT1 after engine warms up past thermostat opening temperature specification.

Follow-On Procedure

None

Engine Cooling Fan Test

Overview

This test is used to check the engine cooling fan for proper operation.

Tools Required

- Breakout Harness ZTSE4908
- Digital Multimeter (DMM)

Equipment Condition

none

Test Setup

1. Remove Engine Fan Relay

Test Procedure

1. Key OFF.
2. Using DMM, measure resistance between relay terminals 30 and 87.

- If resistance is > 1000 ohms, continue.
- If resistance is < 1000 ohms, replace rela.y

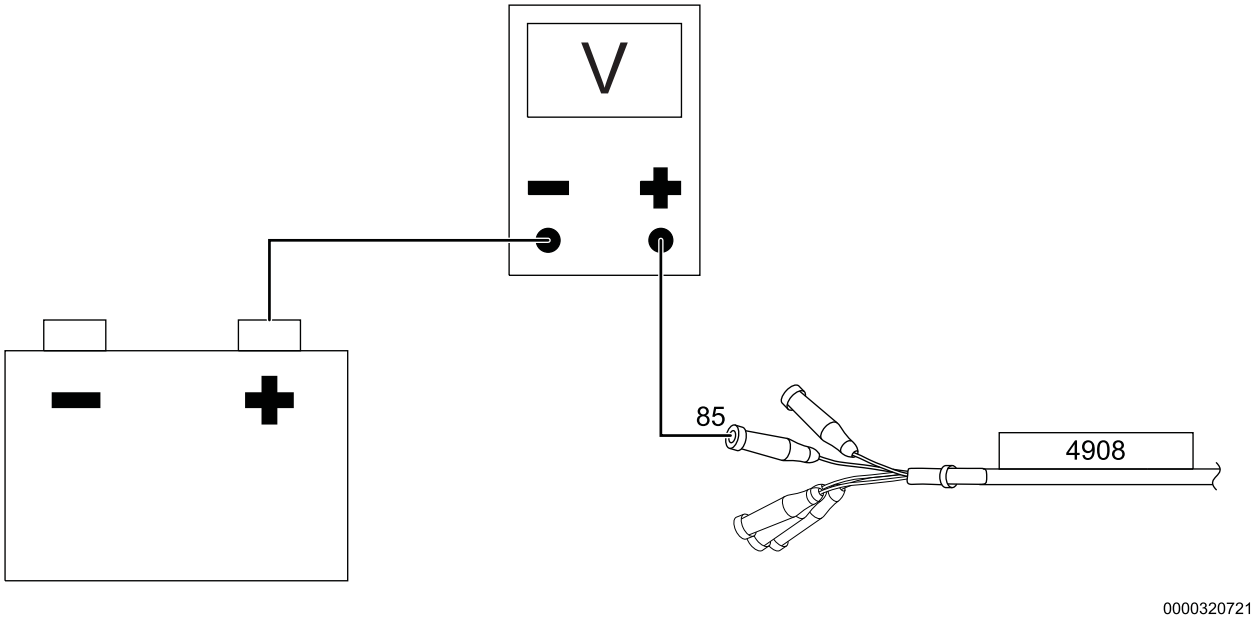


Figure 1041 Engine Fan Relay Control Circuit Voltage Check

3. Connect Breakout Harness ZTSE4908 to relay vehicle harness connector and leave Engine Fan Relay disconnected.

4. Key ON.
5. Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-85 and PWR.

- If voltage is < 0.5 volts, continue.
- If voltage is > 0.5 volts, repair short to GND in Engine Fan Control (EFC) circuit between ECM pin C-58 and Engine Fan Relay.

6. Use DMM to measure voltage between Breakout Harness ZTSE4908 pin-87 and a known good ground.

- If voltage is < 0.5 volts, perform Engine Fan Clutch tests. See appropriate truck service manual.
- If voltage is > 0.5 volts, repair short in vehicle wiring harness between engine fan power feed and engine fan switched power circuits.

Expected outcome

Engine Fan Relay is not stuck closed, no circuit shorts are present, and fan clutch is not mechanically stuck on.

Air Compressor Coolant Leak Test

Overview

This test is used to check if the air compressor is leaking air into the cooling system.

Tools Required

None

Equipment Condition

None

Test Setup

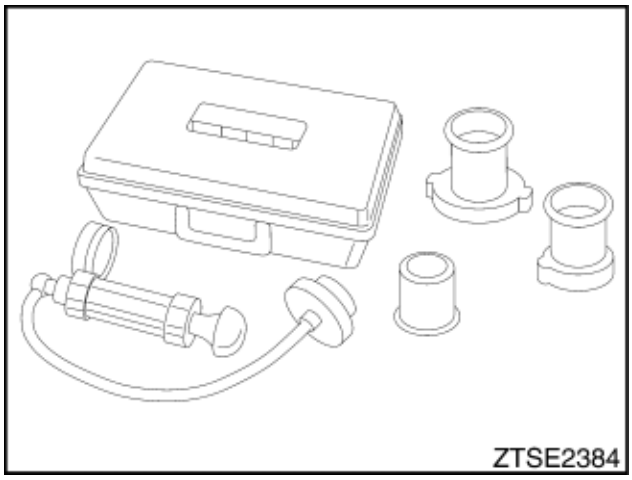


Figure 1042 Radiator Pressure Test Kit ZTSE2384

1. Perform Coolant Leak – Visual Inspection. (page 2360).
2. Maintain a cooling system pressure of 15 psi (103 kPa).

Test Procedure

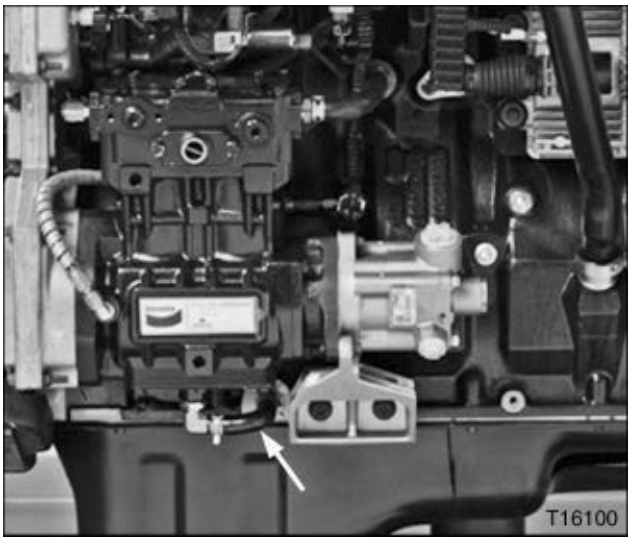


Figure 1043 Air Compressor

1. Disconnect oil return hose from bottom of compressor (Figure 1043).
2. Monitor any fluid coming from hose and check for coolant.

Expected Outcome

No coolant will leak from oil return hose.

Follow-on Procedure

None

Air Compressor Overflow Test

Overview

To determine if cooling system over heats or forces coolant out of overflow tube on deaeration tank due to a faulty air compressor.

Tools Required

None

Equipment Condition

None

Test Setup

1. Disconnect discharge tube from air compressor housing.

Test Procedure

1. Start engine and run until reaching normal operating temperature.
2. Raise engine speed to high idle. Check for coolant overflow out of deaeration tank.
3. Run engine to above 225°F / radiator intake temperature above 200°F.
4. Check for coolant overflow out of deaeration tank overflow hose.

Expected Outcome

Air Compressor will not cause coolant to be expelled from overflow hose on deaeration tank.

Follow-on Procedure

None

Combustion in Cooling System Test

Overview

Check for presence of combustion gasses and/or compressed air in the cooling system.

Tools Required

- Combustion in Cooling System Test Kit – 09-889-01

Equipment Condition

None

Test set-up

1. Remove cap from deaeration tank and if necessary, fill coolant to proper level.

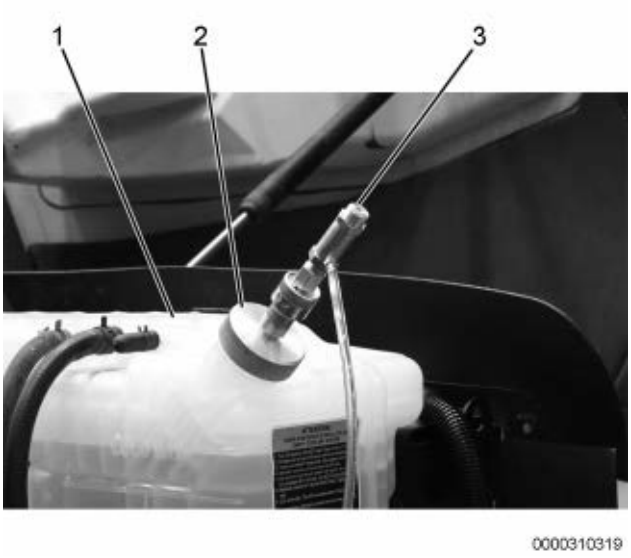


Figure 1044 Deaeration Tank with Test Kit Adapter Installed

1. Deaeration Tank
2. Cap Adapter
3. Combustion tester with tube

2. Install Cap Adapter (item 2) and combustion Tester (item 3) onto deaeration tank (item 1) (Figure 1044).



3. Fill test beaker (item 1) (Figure 1045) to half way mark with clean tap water and place it on a stable surface.
4. Insert combustion tester tube (item 2) (Figure 1045) into water.

Test Procedure

1. Start Engine
2. Observe tester tube in water for air bubbles escaping.
3. Slowly increase engine speed to high idle while observing tester tube in water for air bubbles escaping.
4. Return engine speed to low idle and turn engine off.

Expected Outcome

There will not be a steady flow of air bubbles escaping from tester tube.

Follow-On Procedure

None

On-Engine EGR Cooler Leak Test

Overview

This test is used to check Exhaust Gas Recirculation (EGR) cooler for coolant leakage.

Tools Required

- Coolant Management Tool KL5007NAV
- EGR Cooler Leak Detection Kit KL20030NAV

Equipment Condition

None

Test Setup

1. Chock wheels and disconnect battery.
2. Drain cooling system using Coolant Management Tool KL5007NAV.
3. Remove passenger side inner fender.
4. Remove alternator.
5. Remove alternator mounting bracket.
6. Remove coolant supply and coolant return tubes from front of Exhaust Gas Recirculation (EGR) cooler.



Figure 1046 Deaeration Fitting with EGR Leak Detection Kit KL20030NAV

7. Attach plug 20020-1 from EGR Cooler Leak Detection Kit KL20030NAV onto deaeration fitting as shown in Figure (Figure 1046).

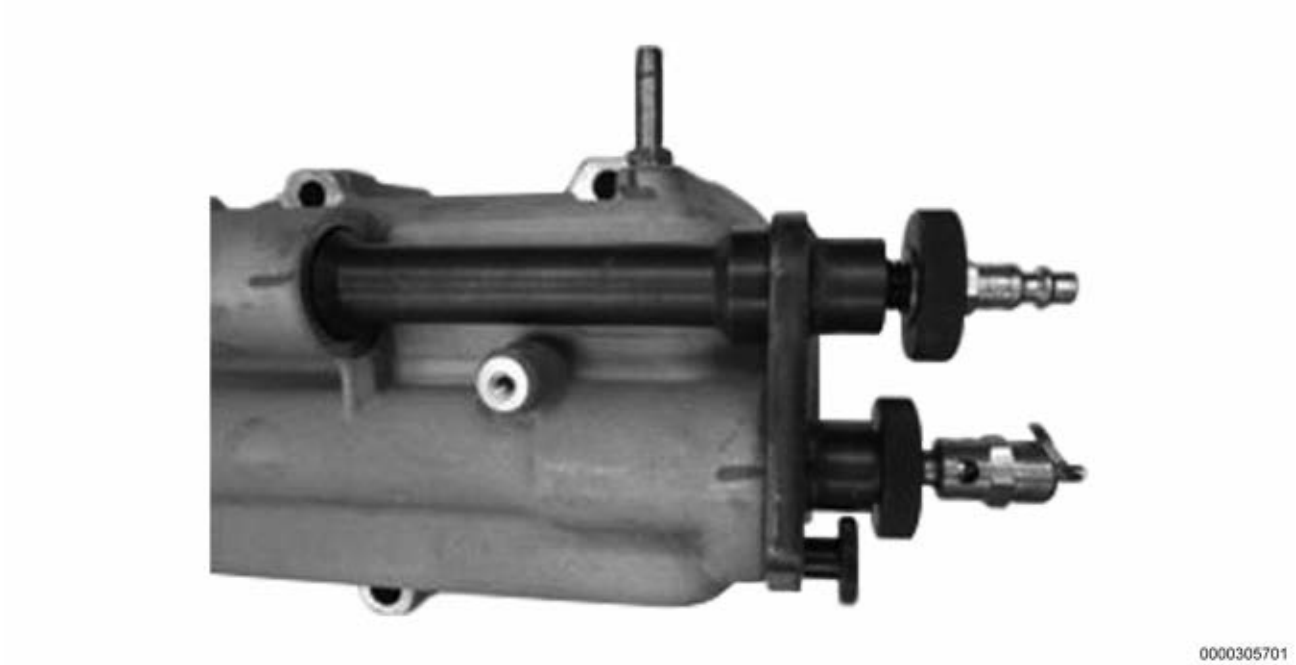


Figure 1047 Coolant Ports and Coolant Port Plug Assembly 20020-2

8. Attach coolant port plug assembly 20020-2 into coolant ports, as shown in Figure (Figure 1047).



Figure 1048 Air Hose Fitting with Extention

9. Attach a pressure regulator with a shut-off valve to air hose fitting (an extension hose may be necessary to reach, as shown in Figure (Figure 1048)). Ensure air hose and fittings are free of any leaks, as they will appear as false EGR cooler leaks.

Test Procedure

1. Pressurize Exhaust Gas Recirculation (EGR) cooler to 55 psi (379 kPa) and shut off air valve.
2. Monitor gauge for 10 minutes.

Expected Outcome

Pressure should drop less than 5 psi.

Follow-On Procedure

None

Instrument Cluster Temperature Gauge Validation Test

Overview

Verifies that the instrument cluster gauge is functioning properly. The gauge reading and sensor signal value are compared to ensure proper operation and proper reading for the operator to monitor.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant, supporting J1939 and J1708)

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Check for any active or inactive code(s) relating to coolant temperature (repair these first).

Test Procedure

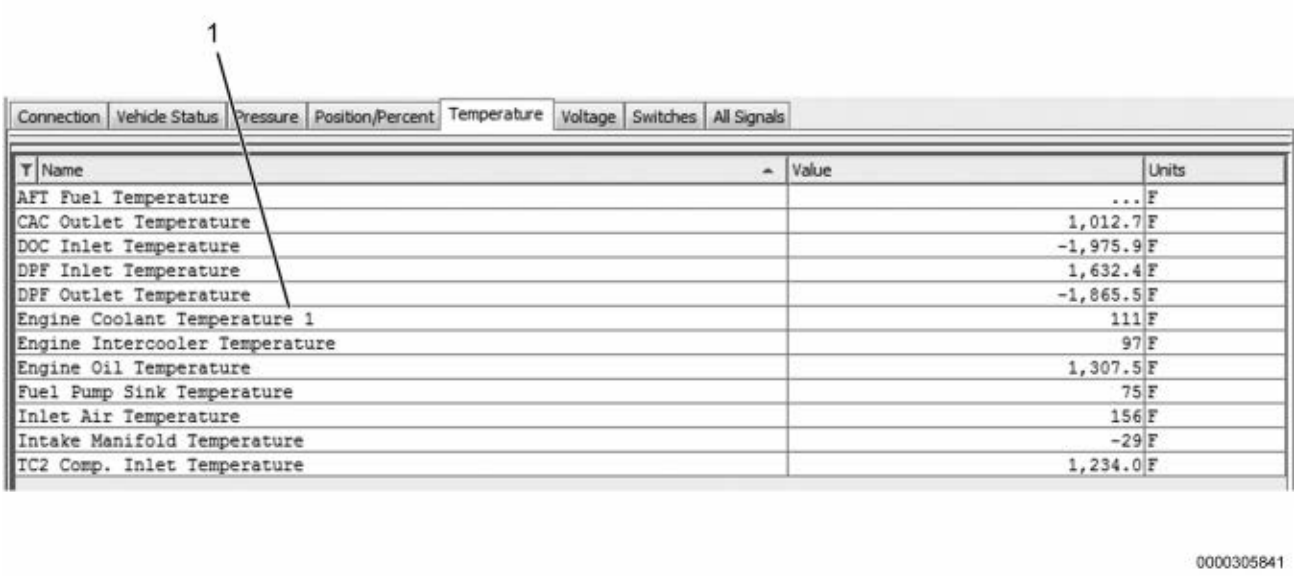


Figure 1049 Monitoring Test

1. Engine Coolant Temperature 1 (ECT1) signal

1. Start engine.

2. Monitor and compare ECT1 sensor signal (Figure 1049) and instrument cluster engine coolant temperature gauge.
3. Bring ECT up to operating temperature and continue to monitor readings for consistency.

Expected Outcome

Instrument Cluster Temperature Gauge and Engine Coolant Temperature (ECT1) sensor signal value will read approximately the same.

Follow-On Procedure

None

Engine Oil Tests

Oil Cooler Pressure Test

Overview

Verifies internal integrity of engine oil cooler. This test uses special tools and compressed air to ensure coolant and lube oil do not mix in the assembly.

WARNING: To prevent personal injury or death, wear safety glasses with side shields.

CAUTION: To prevent damage to oil cooler assembly, regulate compressed air to 30 psi (207 kPa).

Tools Required

- Oil Cooler Test Plate ZTSE4654
- Air Pressure Regulator
- Spray Bottle and Soapy Water

Equipment Condition

1. Remove any truck mounted components to gain access to engine oil cooler assembly.
2. Remove engine oil cooler (refer to *Engine Service Manual*).

Test Setup

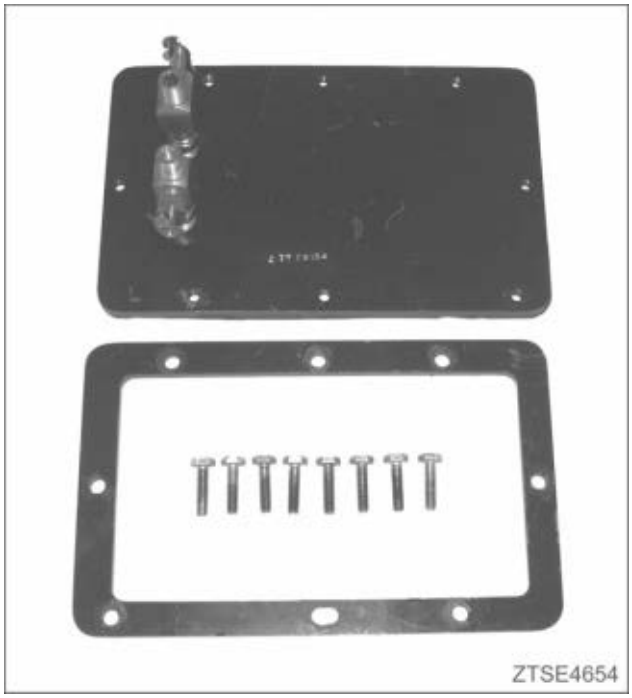


Figure 1050 ZTSE4654 Oil Cooler Test Plate

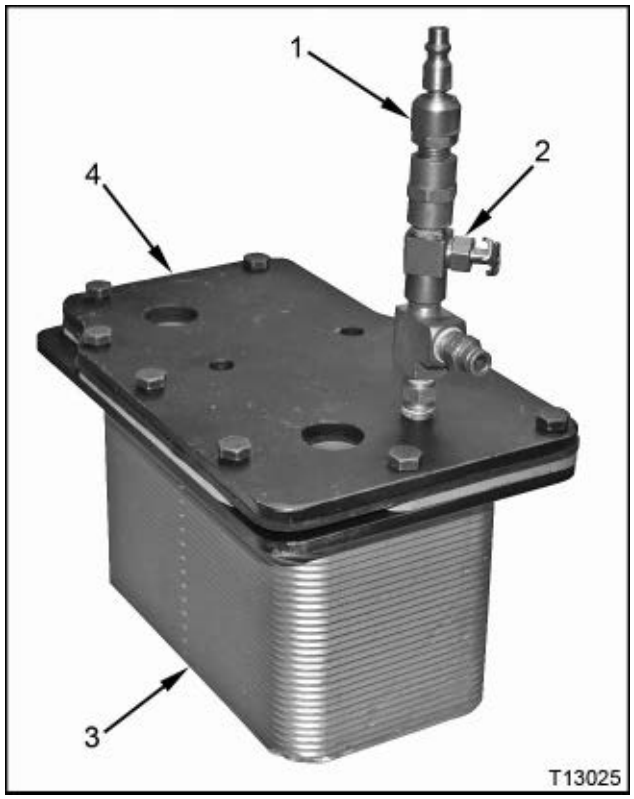


Figure 1051 Oil Cooler

1. Air Pressure Regulator Connector
2. Port Valve
3. Engine Oil Cooler Housing
4. Oil Cooler Test Plate — ZTE4654

1. Attach oil cooler test plate (Figure 1051) (Item 4) to engine oil cooler assembly (Figure 1051) (Item 3).
2. Install port valve in oil cooler test plate (Figure 1051) (Item 4) in coolant port; close valve.
3. Fill oil ports up to 1 / 4 - in. from the top with soapy water.
4. Attach regulated shop air to port valve (Figure 1051) (Item 2). Do not exceed 30 psi (207 kPa).

Test Procedure

1. Open port valve to allow regulated air to enter oil cooler housing.
2. Observe oil cooler housing ports for bubbles.
3. Spray oil cooler housing and test plate with soapy water to ensure air is not leaking.
4. Close valve, and remove and vent compressed air.
5. Disassemble test plate and drain water.
6. Use compressed air to dry inside and outside of oil cooler assembly (if re-using).

Expected Outcome

Oil cooler assembly will not have bubbles in oil ports or on outside of cooler assembly.

Follow-on Procedure

None

Oil Pressure Verification Test

Overview

The Oil Pressure Verification Test verifies the electronic signal for Engine Oil Pressure (EOP) sensor. This test utilizes a mechanical gauge to compare sensor output to actual EOP.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Pressure Test Kit ZTSE4409

Equipment Condition

None

Test Setup

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.

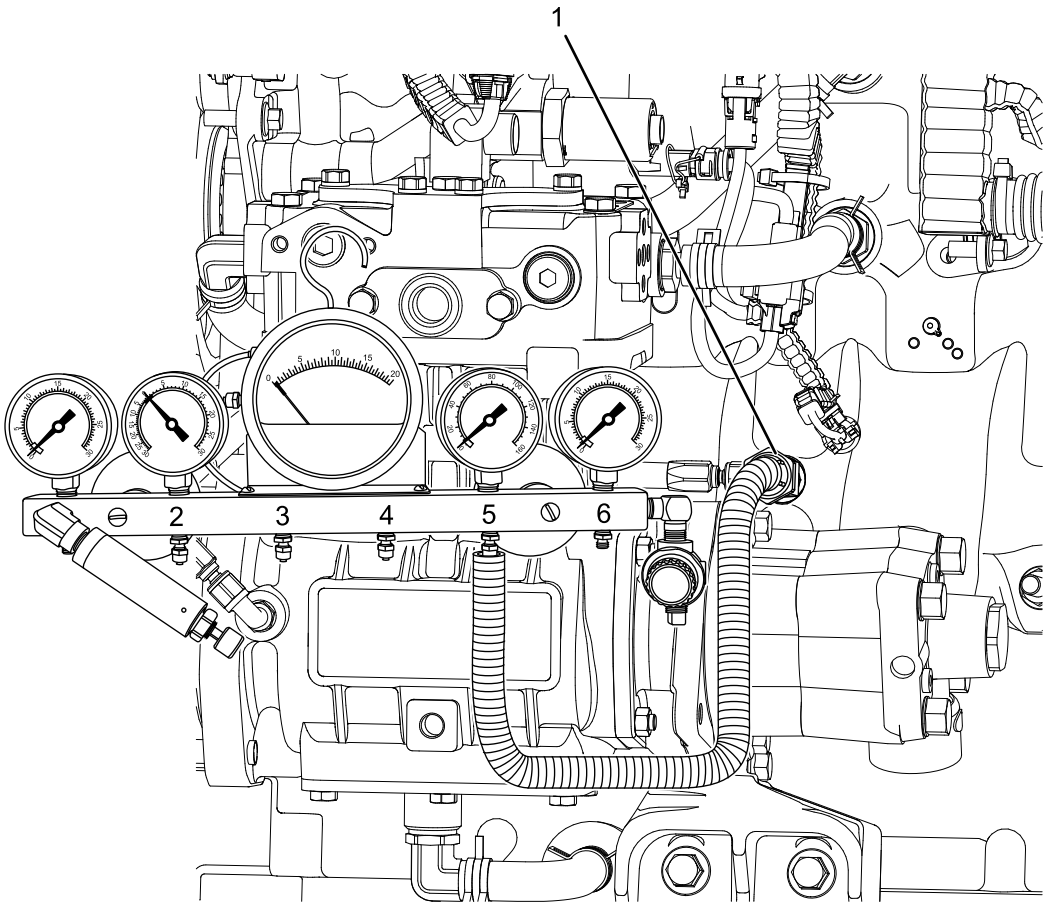


Figure 1052 Oil Pressure Verification Test Connection

1. Engine Oil Pressure sensor connection

4. Connect Pressure Test Kit ZTSE4409 to test port on Engine Oil Pressure (EOP) sensor (Figure 1052) as shown above (if engine is equipped with an air compressor, an in-line adapter should be used here).

Test Procedure

1. Start the engine.
2. At low idle, monitor mechanical gauge for engine oil pressure reading; compare this reading to EOP value in ServiceMaxx™ software.
3. Increase engine speed to high idle.
4. At high idle, monitor mechanical gauge for engine oil pressure reading; compare this reading to EOP value in ServiceMaxx™ software.

Expected Outcome

The Engine Oil Pressure (EOP) reading on mechanical gauge and EOP sensor signal value in ServiceMaxx™ software should be within specification and approximately the same.

Follow-on Procedure

None

Instrument Cluster Engine Oil Pressure Gauge Validation Test

Overview

Verifies the electronic signal to and from the readout of the instrument cluster engine oil pressure gauge approximately matches the actual mechanical reading. This test uses a mechanical gauge and ServiceMaxx™ software to simultaneously read Engine Oil Pressure (EOP).

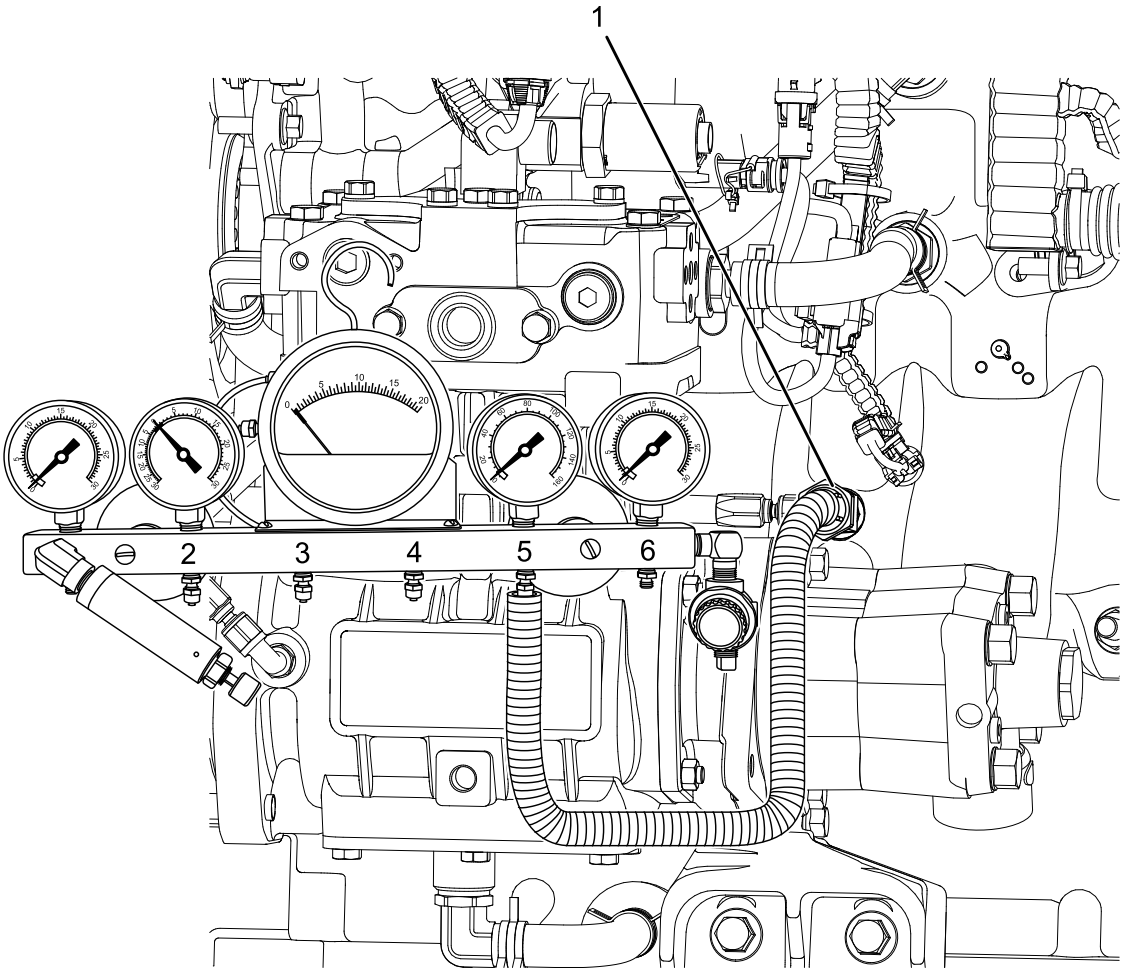
Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™
- Interface cable (RP1210B-compliant supporting J1939 and J1708)
- Pressure Test Kit ZTSE4409

Equipment Condition

None

Test Setup



0000303141

Figure 1053 Pressure Test Kit ZTSE4409

1. Engine Oil Pressure Sensor

1. Key-On Engine-Off (KOEO).
2. Connect Electronic Service Tool (EST) to vehicle Diagnostic Connector (page 2124).
3. Log in to ServiceMaxx™ software.
4. Connect Pressure Test Kit ZTSE4409 to the test port on the EOP sensor (Figure 1053) (if engine is equipped with an air compressor, an in-line adapter should be used here).

Test Procedure

1. Start the engine.
2. At low idle, monitor the mechanical gauge for the engine oil pressure reading. Compare this reading to the value displayed in ServiceMaxx™ software, as well as the value displayed on the instrument panel gauge.

3. Increase engine speed to high idle.
4. At high idle, monitor the mechanical gauge for the engine oil pressure reading. Compare this reading to the value displayed in ServiceMaxx™ software, as well as the value displayed on the instrument cluster gauge.

Expected Outcome

The mechanical gauge, ServiceMaxx™ software, and the instrument cluster gauge will all read approximately the same, indicating the sensor and gauge are working correctly.

Follow-On Procedure

None

Oil Breather Separator Test

Overview

This test is performed to verify the centrifugal oil breather separator is functioning properly. The breather is checked for internal movement by listening for centrifugal noise.

WARNING: To prevent personal injury or death, make sure the parking brake is set, the transmission is in neutral or park, and the wheels are blocked when running the engine in the service bay.

WARNING: To prevent personal injury or death, stay clear of moving parts. Ensure that any long hair or loose clothing is secured appropriately.

Tools Required

- Ultrasonic Ear ZTSE4000

Equipment Condition

None

Test Setup

1. Key-On Engine-Running (KOER).
2. Engine coolant temperature above 158°F (70°C).
3. Ultrasonic Ear ZTSE4800 set up with contact probe installed.

Test Procedure

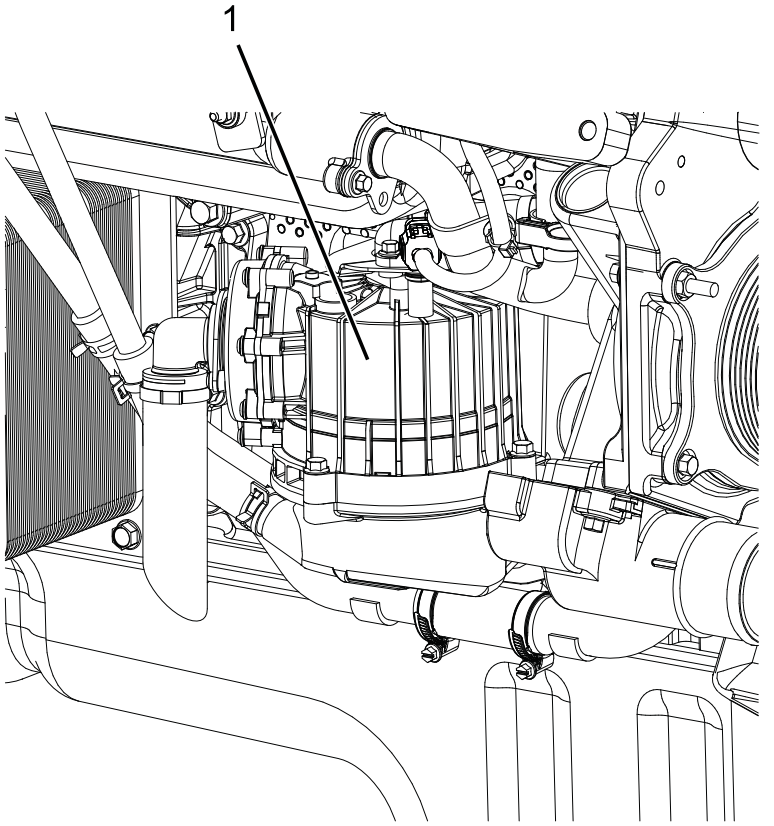


Figure 1054 Crankcase Oil Separator (CCOS)

1. Crankcase Oil Separator (CCOS) housing

1. Turn engine OFF.
2. Place Ultrasonic Ear ZTSE4800 sound probe on Crankcase Oil Separator (CCOS) housing (Figure 1054) (Item 1).
3. Listen for the sound of centrifugal movement inside the CCOS.
4. Repeat steps 1 through 4 as necessary. CCOS will spin approximately 15 seconds after engine is turned off.

Expected Outcome

Centrifugal or spinning sound will be heard inside the Crankcase Oil Separator (CCOS).

Follow-on Procedure

None

Oil Aeration Test

Engine Brake

Engine Brake Operational Check

CONTENT
UNDER
DEVELOPMENT

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Engine Brake ECM Input Check

CONTENT
UNDER
DEVELOPMENT

0000305681

Engine Brake Slave Piston Binding Test

CONTENT
UNDER
DEVELOPMENT

0000305681

Engine System Inspections

Fuel System Inspection

Overview

Verify the fuel system is clean and free of damage.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

Tools Required

None

Equipment Condition

None

Inspection Procedure

1. Visually inspect the condition and routing of fuel lines and connections.
   - If fuel lines or connections are damaged or routed incorrectly, repair or replace as necessary.
   - If fuel lines and connections are in good condition and routed correctly, go to step 2.
2. Remove fuel pump and fuel strainer. Inspect fuel strainer, fuel pump, and O-ring seals for cleanliness and damage.
   - If fuel pump, fuel strainer, or O-ring seals are dirty or damaged, replace as required.
   - If fuel pump, fuel strainer, or O-ring seals are clean and not damaged, go to step 3.
3. Remove fuel filter and inspect for: sediments, gasoline, kerosene, waxing, or icing.
   - If fuel filter is dirty or damaged, replace fuel filter.
   - If fuel filter is clean, go to next test.
4. Inspection is complete.

Expected Outcome

Fuel lines, fuel filter, fuel strainer, and fuel connections are clean and not damaged.

Fuel Quality Inspection

Overview

Drain fuel filter assembly and check fuel quality.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

NOTE: Ultra Low Sulfur Diesel (ULSD) fuel is required for Navistar® Diesel Engines used with advanced aftertreatment systems.

NOTE: Do not continue diagnostic procedures if fuel is contaminated.



Tools Required

- Clear fuel container

Inspection Procedure

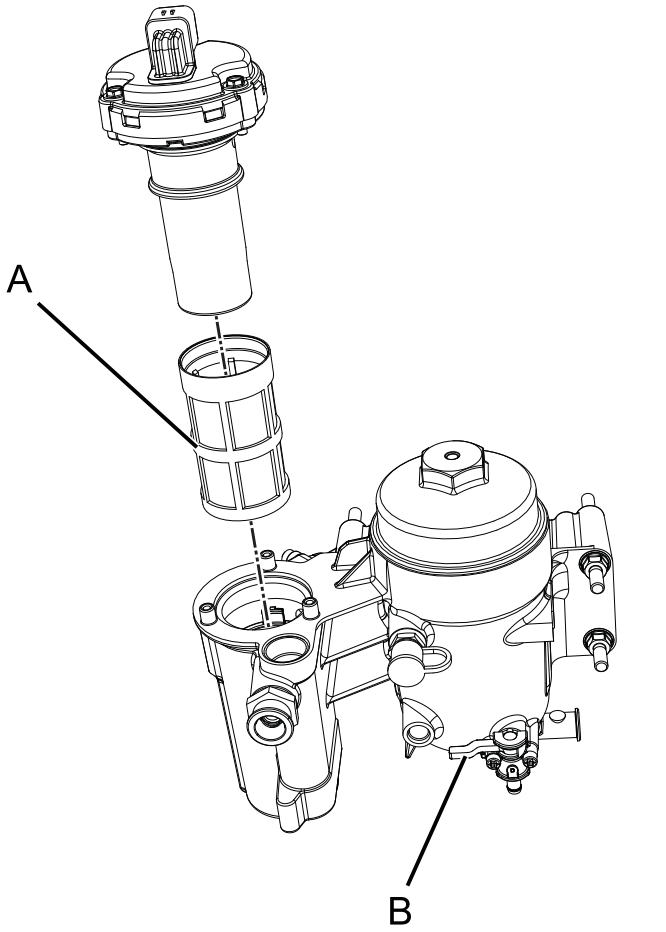


Figure 1059 Fuel Filter Assembly

A. Fuel strainer B. Fuel drain valve

1. Place clear diesel fuel container under fuel-filter housing.
2. Open drain valve (Figure 1059) (Item B) and fill container.
3. Check for water, waxing, icing, sediment, gasoline, kerosene, or Diesel Exhaust Fluid (DEF) by shaking fuel sample container and letting contents settle.
   - Sediments will fall to bottom of fuel sample container.
   - Gasoline and kerosene will separate from diesel fuel.
   - Waxing or icing will prevent diesel fuel flowing from fuel-drain valve.
4. Inspect fuel strainer (Figure 1059) (Item A) for debris.

Expected Outcome

Fuel is free of water, waxing, icing, sediment, gasoline, kerosene, or Diesel Exhaust Fluid (DEF).

Fuel Level Inspection

Overview

This inspection is to verify that the instrument panel fuel gauge indicates the correct fuel level in the fuel tanks.

WARNING: To prevent personal injury or death, do not smoke and keep fuel away from flames and sparks.

Tools Required

None

Equipment Condition

None

Inspection Procedure

1. Inspect interior of fuel tanks and ensure fuel level is equal in both tanks.
2. Check instrument panel fuel gauge and verify that indicated fuel level is consistent with actual fuel level.

Expected Outcome

Fuel gauge should function properly and indicate correct fuel level in fuel tanks.

Engine Oil and Quality Check

Overview

The following procedure is for the inspection of engine oil level and engine oil quality.

NOTE: API CJ-4 oils are recommended for use in high-speed diesel engines with advanced-exhaust aftertreatment systems that meet on-highway exhaust emissions standards for year 2007 and beyond.



Figure 1060 API CJ-4 Oil Label

NOTE: If inspection indicated that engine oil is contaminated or diluted, engine oil and filter must be replaced.

Tools Required

None

Equipment Condition

None

Inspection Procedure

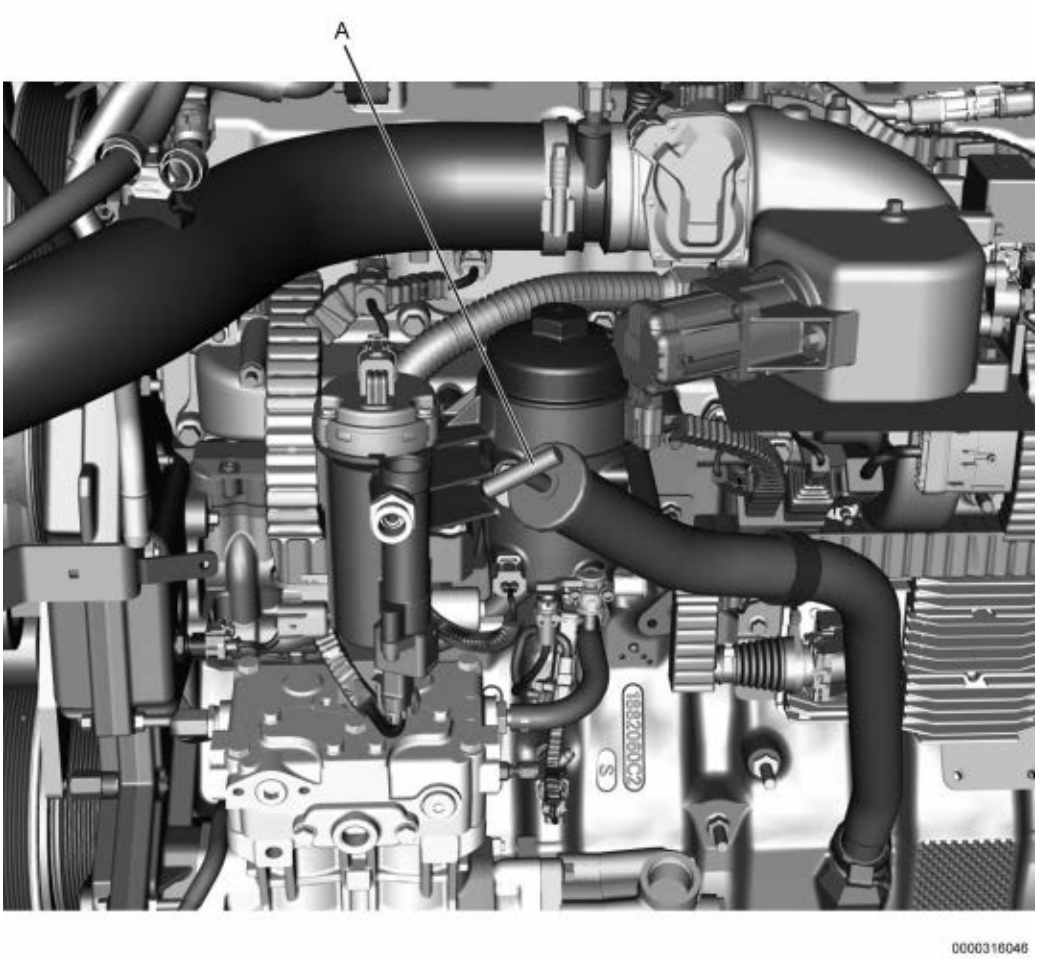


Figure 1061 Engine Oil Level Gauge

1. Use oil level gauge (dipstick) (Figure 1061) (Item A) to check engine oil level.
    - If engine oil level is below specification, inspect engine for leaks, oil consumption, or improper servicing. Repair cause of low engine oil prior to filling to proper level.
    - If engine oil level is above specification, inspect for fuel dilution, coolant contamination, or improper servicing. If engine oil level is above specification, drain to proper level and diagnose cause of dilution, contamination, or improper servicing.

Expected Outcome

Oil level should be within specification and free of dilution, coolant contamination, and improper servicing.

Coolant Level Inspection

Overview

The following procedure is to inspect that coolant in the deaeration tank is at appropriate level and free of contamination.

Tools Required

None

Equipment Condition

None

Inspection Procedure

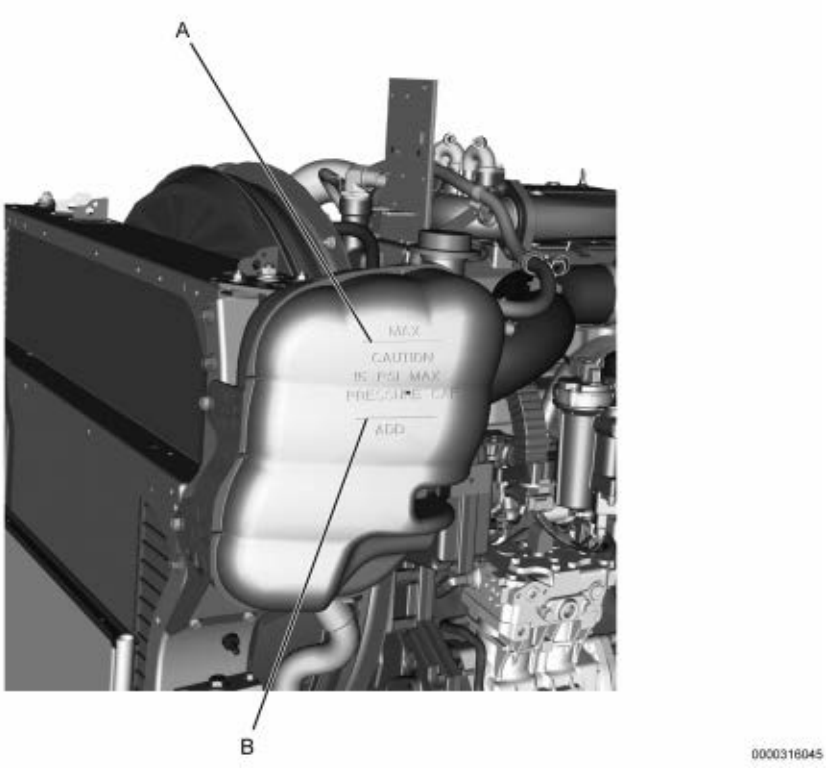


Figure 1062 Deareation Tank Location (Typical)

A. Maximum level indicator
B. Add coolant indicator

1. Inspect coolant level in deaeration tank.

Expected Outcome

Coolant level should be within specification and free of contaminants.

Coolant Quality Inspection

Overview

Check coolant for proper freeze point, and for contamination.

Tools Required

- Coolant and Battery Refractometer ZTSE4796

Equipment Condition

- Park the vehicle on level ground.
- If engine was running, allow engine to cool for 15 minutes or more.

Inspection Procedure

1. Wrap a thick cloth around the deaeration cap.
2. Loosen cap slowly a quarter to half turn to vent pressure.
3. After pressure has been released, remove the cap.
4. Check coolant appearance for signs of contamination.
5. Take a sample from the deaeration tank.
6. Examine sample for lube oil and Diesel Exhaust Fluid (DEF).
    - Oil contamination will result in a dark sludge.
    - DEF contamination will give the coolant a dark yellow/brown color with a strong ammonia smell.
7. If coolant is not contaminated, check freeze point.

Expected Outcome

Coolant should be free of contamination, and at the correct freeze point.

Coolant in Exhaust Inspection

Overview

Determine if engine coolant is in the exhaust system.

Tools Required

- Radiator Pressure Test Kit ZTSE2384

Inspection Procedure

1. Park the vehicle on level ground. If engine was running, allow engine to cool for 15 minutes or more.
2. Wrap a thick cloth around the deaeration cap. Slowly turn cap counter-clockwise one-quarter to one-half turn to vent pressure. After pressure has been released, remove the cap.
3. Install the Radiator Pressure Test Kit ZTSE2384 (with appropriate adapter if needed) onto the deaeration tank.
4. Disconnect the exhaust pipe at the exhaust brake housing (see *Engine Service Manual*).
5. Pressurize cooling system to 15 psi (103 kPa).
6. Inspect exhaust pipe and brake housing for presence of engine coolant and engine coolant residue.

Expected Outcome

Exhaust system will not have engine coolant or engine coolant residue.

Interstage Cooler (ISC) Coolant Leak Inspection

Overview

Inspect the Interstage Cooler (ISC) and the High-Pressure (HP) Turbocharger intake elbow for evidence of coolant.

WARNING: To prevent personal injury or death, allow engine to cool before removing components.

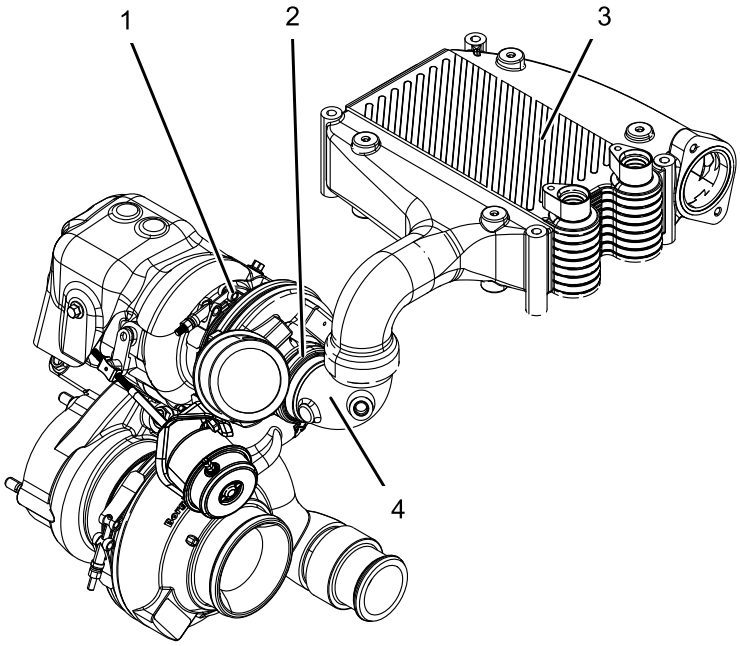
WARNING: To prevent personal injury or death, do the following when removing radiator or deaeration cap:

- **Allow engine to cool for 15 minutes or more.**
- **Wrap a thick cloth around radiator cap or deaeration cap.**
- **Loosen cap slowly a quarter to half turn counterclockwise to vent pressure.**
- **Continue to turn cap counterclockwise to remove.**

Tools Required

- Radiator Pressure Test Kit ZTSE2384

Equipment Condition



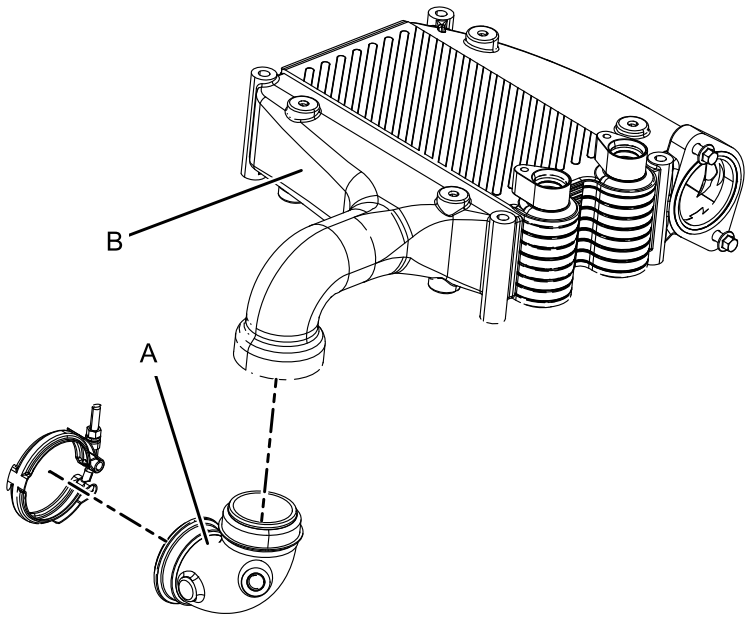
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Figure 1063 HP Turbocharger / ISC Assembly

1. High-Pressure (HP) Turbocharger compressor housing
2. Intake elbow clamp
3. Interstage Cooler (ISC)
4. Intake elbow

1. Install the Radiator Pressure Test Kit ZTSE2384, with appropriate adapter if needed, on the deaeration tank.
2. Pressurize cooling system to 15 psi (103 kPa).
3. Remove the High-Pressure (HP) Turbocharger intake elbow clamp (Figure 1063) (Item 2).
4. Remove intake elbow (Figure 1063) (Item 4) from HP Turbocharger compressor housing (Figure 1063) (Item 1) and ISC (Figure 1063) (Item 3) (see Engine Service Manual).

Inspection Procedure



0000341001

Figure 1064 ISC Assembly

A. Intake elbow
B. Interstage Cooler (ISC)

1. Check intake elbow (Figure 1064) (Item A) and ISC (Figure 1064) (Item B) for wet coolant and the residue of coolant.

Expected Outcome

No evidence of coolant or coolant residue will be found in the ISC or the HP-Turbocharger intake elbow.

Coolant Leak Visual Inspection

Overview

Check engine cooling system for proper level and leaks.

Tools Required

- Radiator Pressure Test Kit ZTSE2384

Equipment Condition

None

Inspection Procedure

1. Park vehicle on level ground. If engine was running, allow engine to cool for 15 minutes or more.
2. Wrap a thick cloth around the deaeration cap. Loosen cap slowly a quarter to half turn to vent pressure. After pressure has been released, remove the cap.
3. Check coolant level. Compare coolant level to level indicators on the deaeration tank. If coolant level is low, add coolant.
4. Install Radiator Pressure Test Kit ZTSE2384.
5. Pressurize cooling system.
6. Check both sides of vehicle for coolant, leaks, and coolant on the ground.
7. If coolant is leaking, determine what component is leaking.

Expected Outcome

Coolant should be at the correct level. There should be no visible coolant leaks.

Coolant To Intake Inspection

Overview

Inspect the High-Pressure (HP) Turbocharger and intake elbow for evidence of coolant.

Tools Required

- Radiator Pressure Test Kit ZTSE238

Equipment Condition

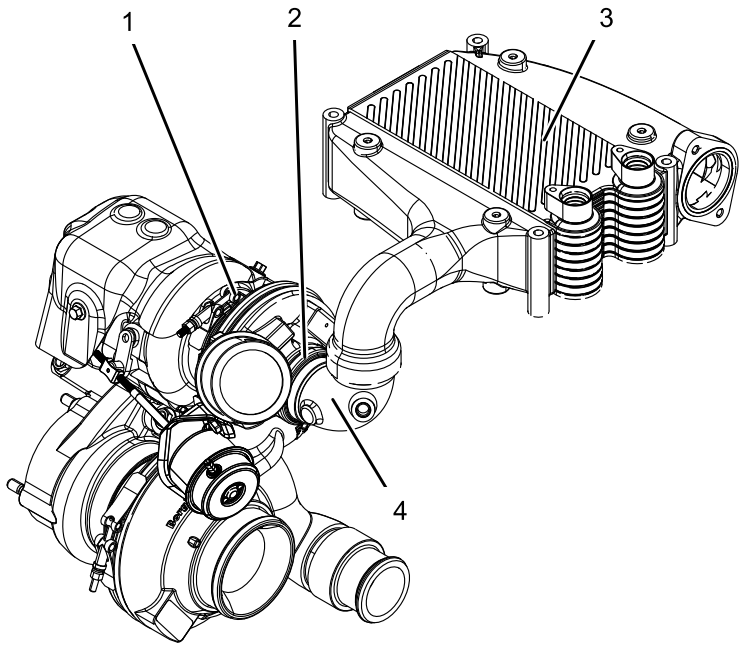


Figure 1065 HP Turbocharger / ISC Assembly

1. High-Pressure (HP) Turbocharger compressor housing
2. Intake elbow clamp
3. Interstage Cooler (ISC)
4. Intake elbow

1. Install the Radiator Pressure Test Kit ZTSE2384, with appropriate adapter if needed, on the deaeration tank.
2. Pressurize cooling system to 15 psi (103 kPa).
3. Remove intake elbow (Figure 1065) (Item 4) from HP Turbocharger compressor housing (Figure 1065) (Item 1) and ISC (Figure 1065) (Item 3) (see Engine Service Manual).

Inspection Procedure

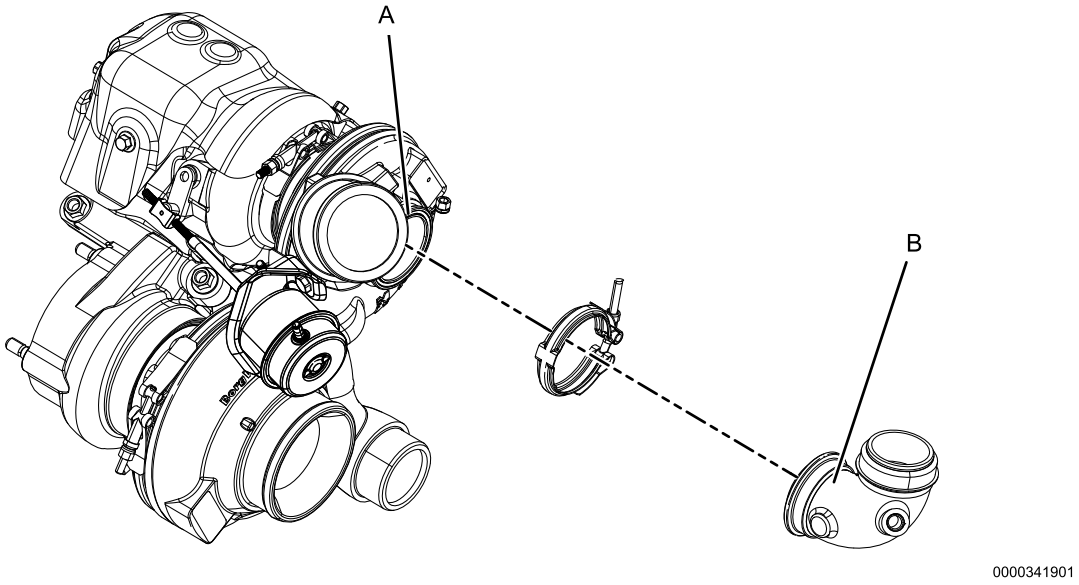


Figure 1066 Coolant To Intake Inspection

A. HP Turbocharger housing intake
B. Intake elbow

1. Inspect HP Turbocharger housing intake (Figure 1066) (Item A) and intake elbow (Figure 1066) (Item B) for coolant and coolant residue.

Expected Outcome

No evidence of coolant or coolant residue will be found in the HP Turbocharger housing intake and intake elbow.

Charge Air Cooler Inspection

Overview

Inspect the High-Pressure Charge Air Cooler (CAC), Interstage Cooler (ISC), and CAC piping for leaking, worn, or damaged parts.

Tools Required

None

Equipment Condition

None

Inspection Procedure

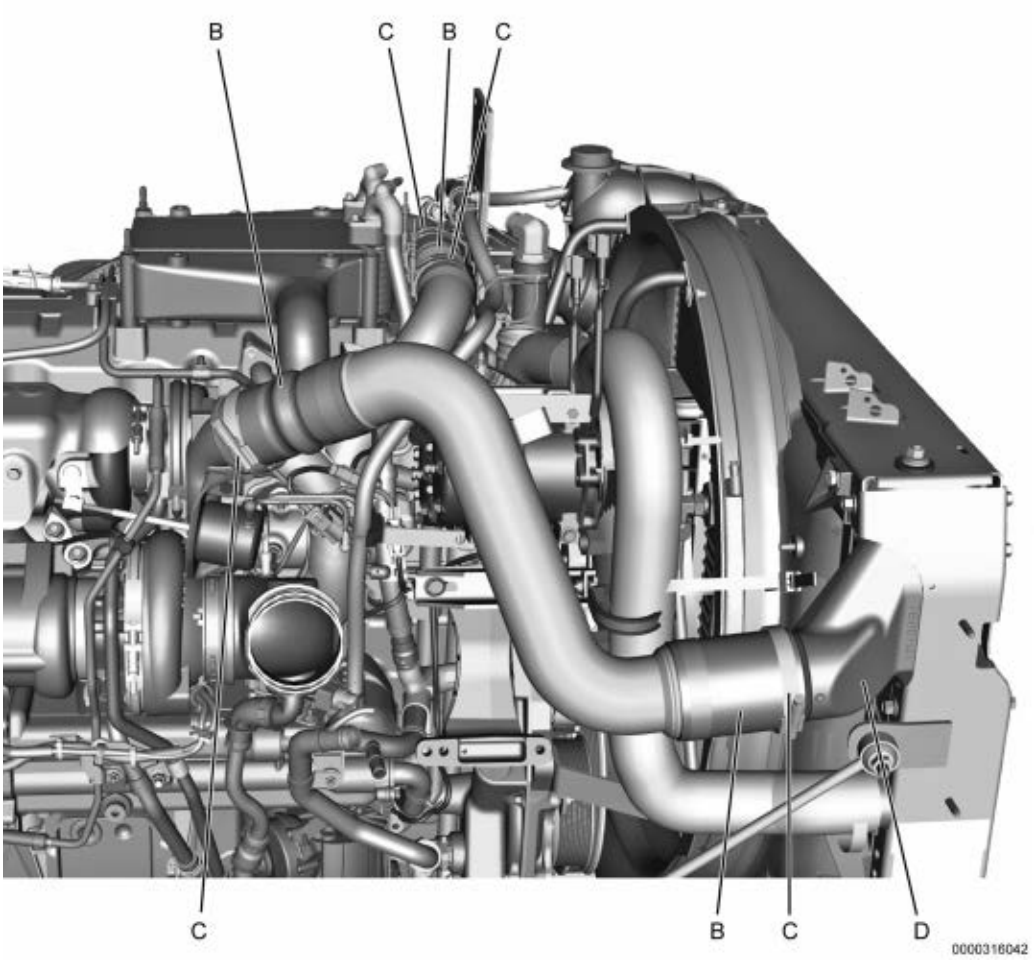


Figure 1067 Right Side Engine View (Typical)

A. Interstage Cooler (ISC)
B. Hose
C. Clamp
D. High-Pressure Charge Air Cooler (HPCAC)
E. Connection point

1. On right side of engine inspect High-Pressure Charge Air Cooler (HPCAC) (Figure 1067) (Item D), associated hoses (Figure 1067) (Item B), and clamps (Figure 1067) (Item C) for leaks and worn or damaged parts.

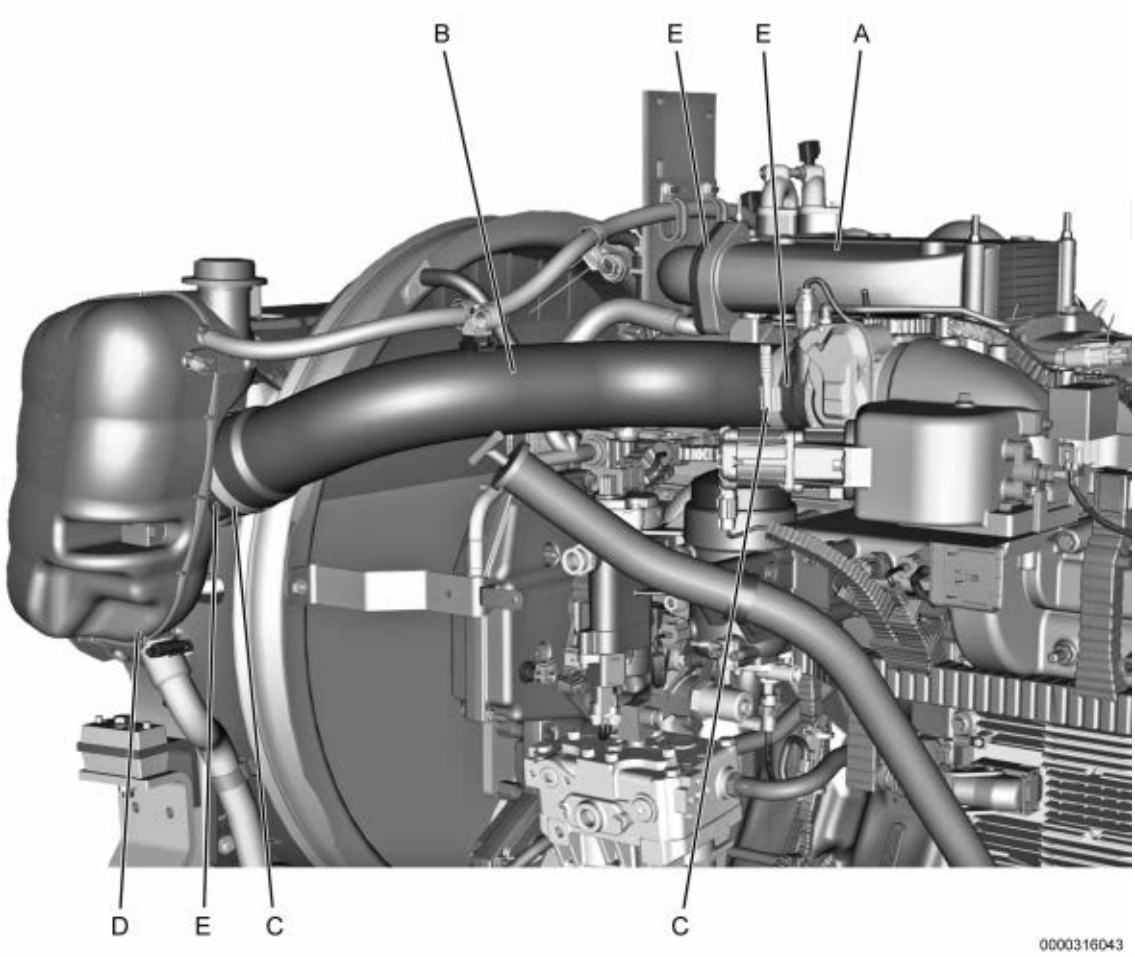


Figure 1068 Left Side Engine View (Typical)

A. Interstage Cooler (ISC)
B. Hose
C. Clamp
D. High-Pressure Charge Air Cooler (HPCAC)
E. Connection point

2. Inspect High-Pressure Charge Air Cooler (HPCAC) (Figure 1068) (Item D), Interstage Cooler (ISC) (Figure 1068) (Item A), associated hoses (Figure 1068) (Item B), clamps (Figure 1068) (Item C) and connections (Figure 1068) (Item E) for leaks and worn or damaged parts.

Expected Outcome

HPCAC, ISC, hoses, clamps and connections are free of leaks, wear, or damage.

Intake Air Inspection

Overview

Inspect the air filter and air intake assembly for blockages and / or damage.

Tools Required

None

Equipment Condition

None

Inspection Procedure

1. Inspect for a dirty, damaged, or incorrectly installed air filter.
   - If air filter is clean, undamaged, and correctly installed, go to next step.
   - If air filter is dirty or damaged, replace air filter.
2. Inspect for air flow restrictions in air intake tubing, tubing connections, and filter housing.
   - If air flow is restricted repair air flow restrictions.
   - If no air flow restriction is found, no action is required.

Expected Outcome

Air filter, air intake tubing, and air filter housing are free of damage and restrictions. Intake air restriction should be less than 25 in Hg (84.7 kPa) at full load and at rated speed.

Front Gear Train Coolant Leak Inspection

Overview

This test is used to check for signs of coolant leakage into front gear train.

Tools Required

None

Equipment Condition

1. Remove necessary components for removal of front cover.
2. Remove front cover.

Inspection Procedure

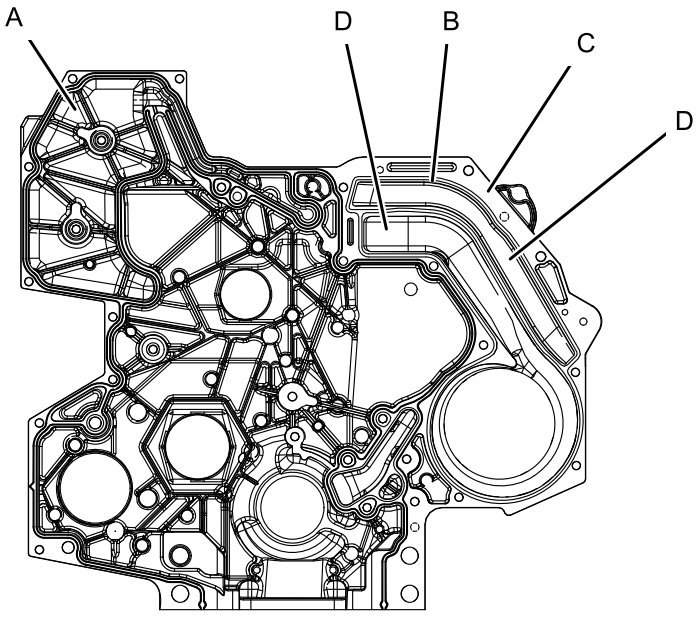


Figure 1069 Front Gear Train Cover

A. Front cover
B. Gasket
C. Sealing surface
D. Coolant passage

1. Inspect gasket (Figure 1069) (Item B), sealing surface (Figure 1069) (Item C), and coolant passages (Figure 1069) (Item D).
2. Check front cover (Figure 1069) (Item A) and crankcase with straight edge and feeler gauge.

Expected Outcome

Gasket is in good condition, and there is no evidence of coolant leakage. Cover straightness is within specification.

Exhaust and Aftertreatment System Inspection

Overview

Inspect exhaust and aftertreatment system for leaks and damage.

Black staining in exhaust tailpipe can occur. This is normal and the Diesel Particulate Filter (DPF) should not be replaced.

Tools Required

None

Equipment Condition

None

Inspection Procedure

1. Inspect exhaust system (engine and vehicle) for restrictions, leaks, and damage.

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PLACE
HOLDER

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Figure 1070 Exhaust and Aftertreatment System

A. Aftertreatment Doser Injector (AFT: DI)
B. AFT: DI Fuel Supply lines
C. AFT: DI gasket
D. AFT: DI bore
E. Coolant Supply and Return line
F. Coolant Supply and Return line

2. Visually inspect Aftertreatment Doser Injector (AFT: DI) fuel supply lines (Figure 1070) (Item B) and coolant supply and return lines (Figure 1070) (Items E and F) for leaks, kinks, bends, or other damage.
3. Remove AFT: DI (see *Engine Service Manual)* and perform visual check for the following:
   - The correct AFT: DI gasket (Figure 1070) (Item C) is installed.
   - AFT: DI (Figure 1070) (Item A) and bore (Figure 1070) (Item D) are unrestricted and free of carbon buildup.
   - AFT: DI tip (Figure 1070) (Item A) is free of cracks and other visible damage.

Expected Outcome

Exhaust system (engine and vehicle) will be free of restrictions, leaks, and/or damage. AFT: DI fuel supply and coolant supply return lines will be free of leaks, kinks, bends, and/or other damage.

Diesel Particulate Filter (DPF) Inspection

Overview

Inspect Diesel Particulate Filter (DPF) channels for restriction, contamination, soot leakage, and filter damage. Inspect exterior for container damage.

Tools Required

None

Equipment Condition

Index and mark components to show direction of exhaust flow. Mark Diesel Particulate Filter (DPF) to ensure proper installation after filter has been cleaned or replaced.

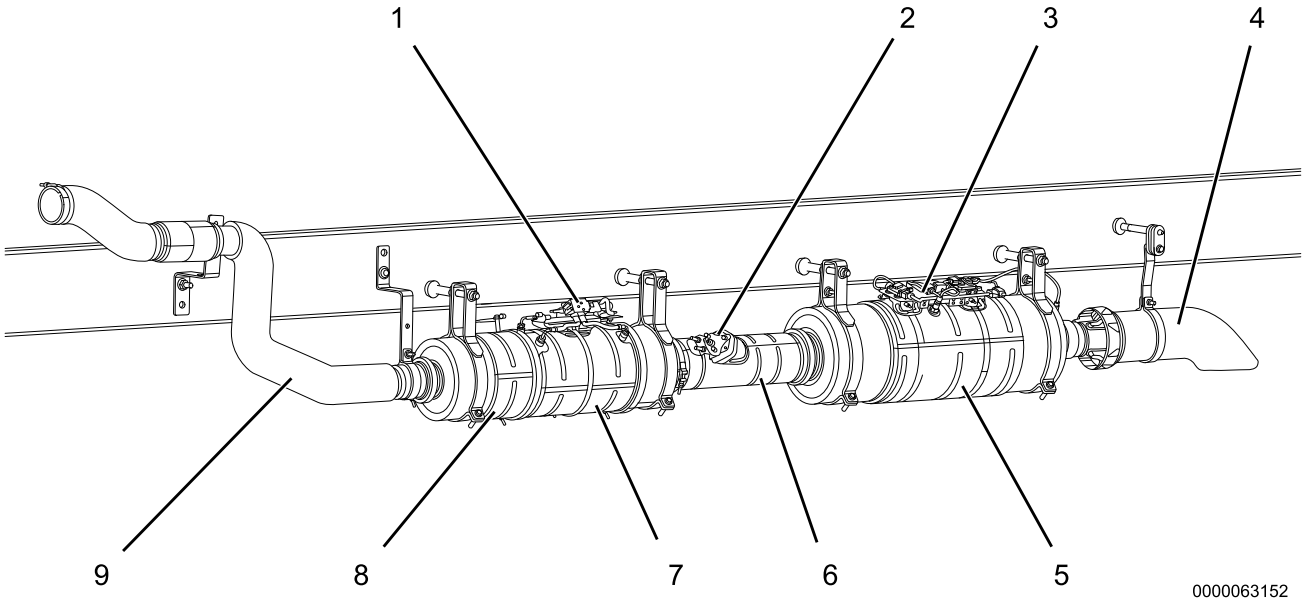


Figure 1071 In-Line Exhaust System

1. Diesel Particulate Filter (DPF) interface module
2. Diesel Exhaust Fluid Dosing Unit (DEF: DU)
3. Selective Catalyst Reduction (SCR) interface module
4. Tailpipe
5. Selective Catalyst Reduction (SCR) canister
6. Decomposition reactor tube
7. Diesel Particulate Filter (DPF)
8. Diesel Oxidation Catalyst (DOC)
9. Turbo pipe

1. DPF (Figure 1071) (Item 7) may need to be removed for inspection. There are several variations of exhaust systems depending on the specific truck series. All variations have the same components and removal/installation procedures are similar for the different variations. Follow procedures in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Inspection Procedure



Figure 1072 New Diesel Particulate Filter (DPF) - face is clear and all channels are visible

1. Inspect the exterior of the Diesel Particulate Filter (DPF) (Figure 1071) (Item 7).
2. If the DPF shows signs of exterior damage such as dents or cracks, replace DPF.
3. Inspect the DPF intake and outlet.
4. If all channels are visible (Figure 1072) and the light soot coating over the whole face is easily wiped away with a finger, system is working correctly. No action is required.
5. If the DPF is plugged with ash, remove DPF and clean or replace.
6. If filter is cracked or melted, the source of the excessive soot that caused the cracking or melting must be investigated and the filter must be replaced.
7. Follow Diesel Oxidation Catalyst (DOC) and DPF Reuse Guidelines in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Expected Outcome

Diesel Particulate Filter (DPF) should be free of contamination, soot leakage, and filter damage. DPF channels should be free of restrictions.

Diesel Oxidation Catalyst (DOC) Inspection

Overview

Inspect Diesel Oxidation Catalyst (DOC) for restriction, contamination, soot leakage, and melted or deformed cells.

Tools Required

None

Equipment Condition

Before removal, mark the DOC to show the direction of exhaust flow. Marking the DOC ensures proper installation after the DOC has been cleaned or replaced.

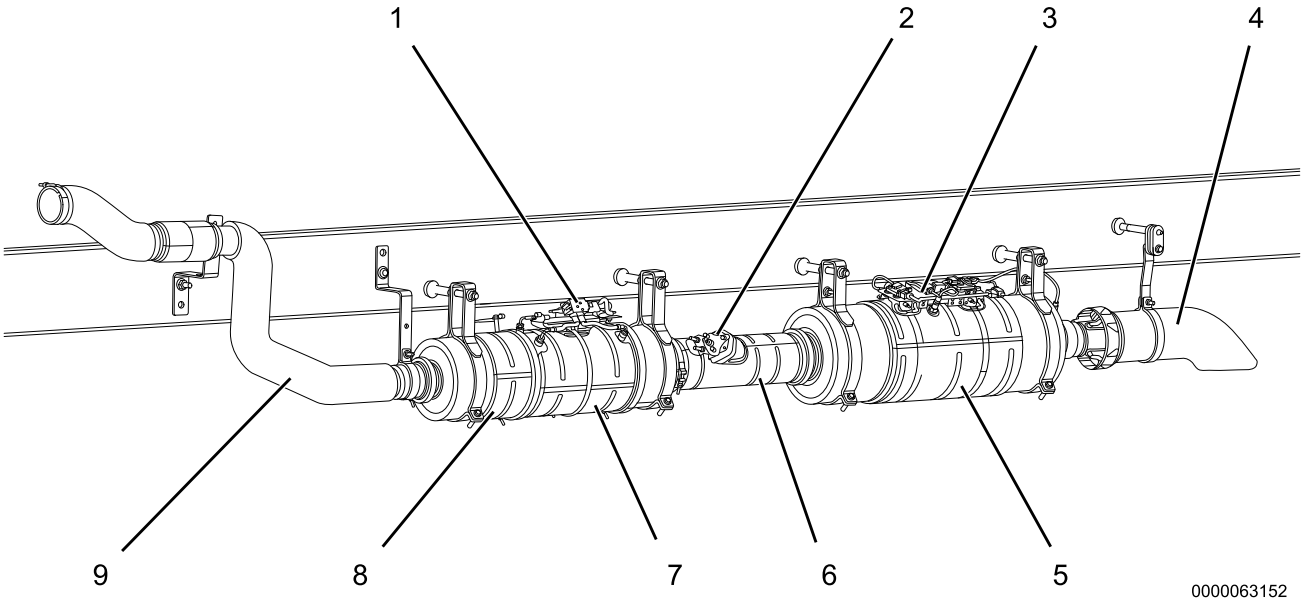


Figure 1073 In – Line Exhaust System

1. Diesel Particulate Filter (DPF) interface module
2. Diesel Exhaust Fluid Dosing Unit (DEF: DU)
3. Selective Catalyst Reduction (SCR) interface module
4. Tailpipe
5. Selective Catalyst Reduction (SCR) canister
6. Decomposition reactor tube
7. Diesel Particulate Filter (DPF)
8. Diesel Oxidation Catalyst (DOC)
9. Turbo pipe

1. The Diesel Oxidation Catalyst (DOC) may need to be removed to be inspected. There are several variations of exhaust systems depending on the specific truck series. All of the variations have the same components and the removal/installation procedures are similar for the different variations. Follow procedures in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Inspection Procedure

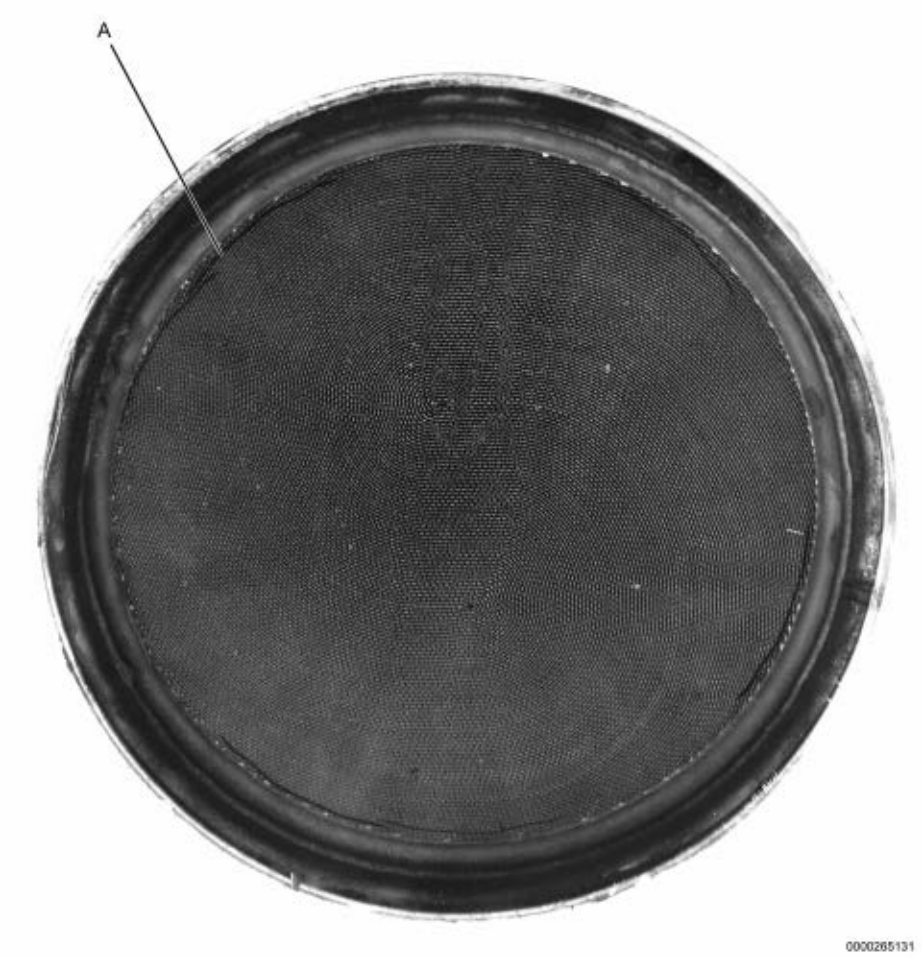


Figure 1074 Diesel Oxidation Catalyst (DOC) Outlet

A. DOC separation between the substrate and housing

1. Inspect DOC.
2. If black soot or gray ash is visible on the face of the DOC, the system is working properly. The DOC can be reused.
3. If inspection shows separation between the substrate and housing(Item A)(Figure 1074), the DOC can be reused.
4. If DOC cells are melted or deformed, determine the cause of excessive exhaust gas temperatures.
5. Repair cause of excessive exhaust gas temperatures. Replace the DOC. Follow procedure in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Expected Outcome

DOC should be free of restriction, contamination, soot leakage, and melted or deformed cells.

Selective Catalyst Reduction (SCR) Inspection

Overview

Inspect Selective Catalyst Reduction (SCR) canister.

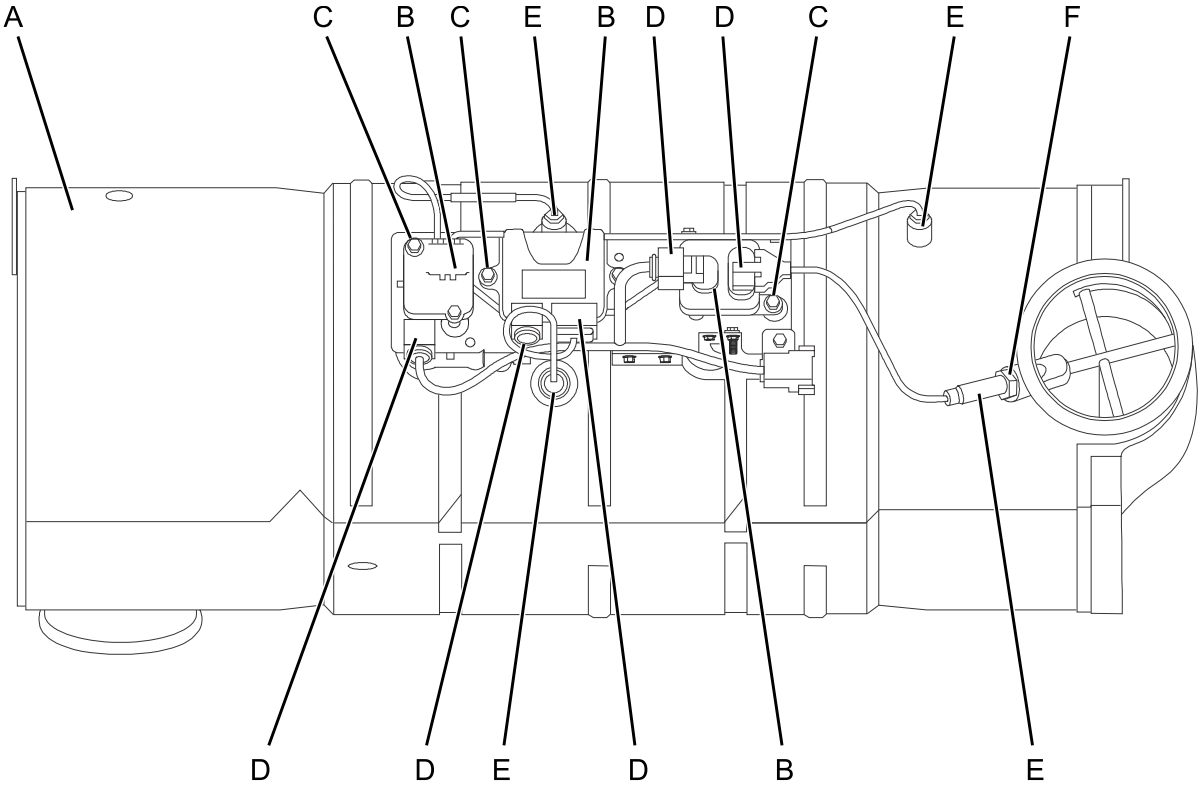
Tools Required

None

Equipment Condition

None

Inspection Procedure



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Figure 1075 Selective Catalyst Reduction (SCR) Assembly

A. SCR canister
B. Sensor module (3)
C. Mounting bolt (6)
D. Electrical connector (5)
E. Sensor (4)
F. Mounting nut (1)

1. Check SCR canister (Figure 1075) (Item A) for exterior damage such as dents or cracks.
2. Check sensors (Figure 1075) (Item E) and sensor modules (Figure 1075) (Item B) for visual damage.
3. Check for loose, damaged, brittle, or cracked wiring or electrical connectors (Figure 1075) (Item D).

4. Check for loose or damaged mounting bolts (Figure 1075) (Item C) or nut (Figure 1075) (Item F).
5. Correct items that fail visual check(s).

Expected Outcome

Selective Catalyst Reduction (SCR) canister should be free of dents of cracks. Sensors and sensor modules should be free of visual damage. Wiring and electrical connectors should pass visual inspection and be in good working order.

Follow-On Procedure

None

Diesel Exhaust Fluid Dosing Unit (DEF: DU) Inspection

Overview

Inspect Diesel Exhaust Fluid Dosing Unit (DEF: DU).

Tools Required

None

Equipment Condition

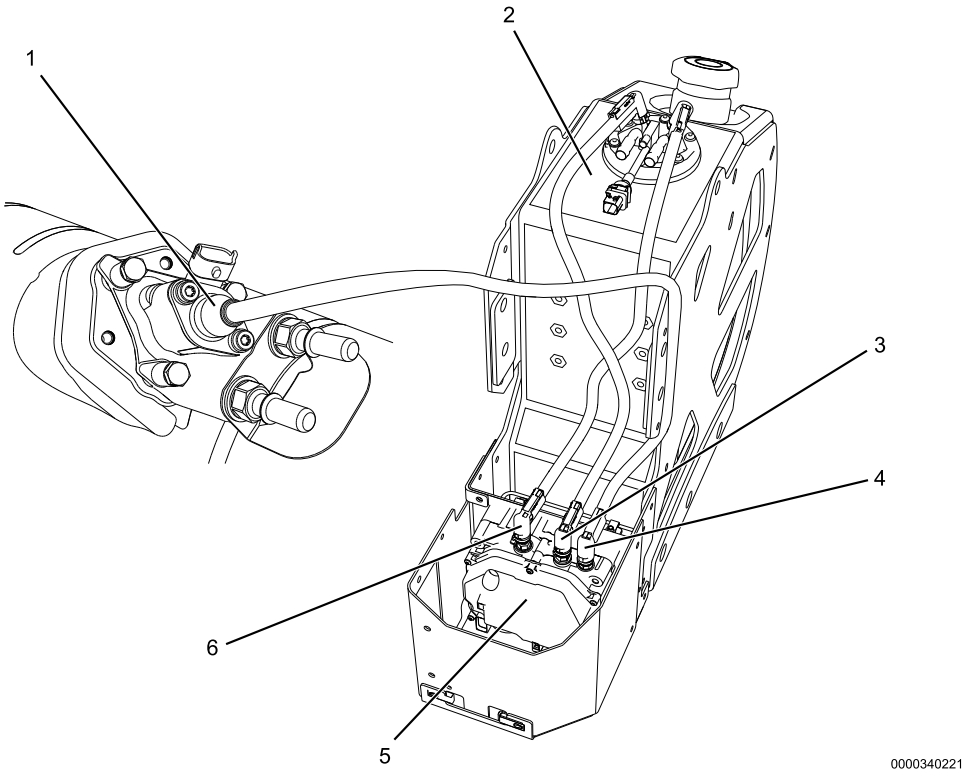


Figure 1076 In-Line Exhaust System

1. Diesel Exhaust Fluid Dosing Unit (DEF: DU)
2. Diesel Exhaust Fluid (DEF) tank
3. DEF return line
4. DEF pressure line
5. DEF supply module
6. DEF suction line

1. Remove Diesel Exhaust Fluid Dosing Unit (DEF: DU) for inspection. Follow procedures in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Inspection Procedure

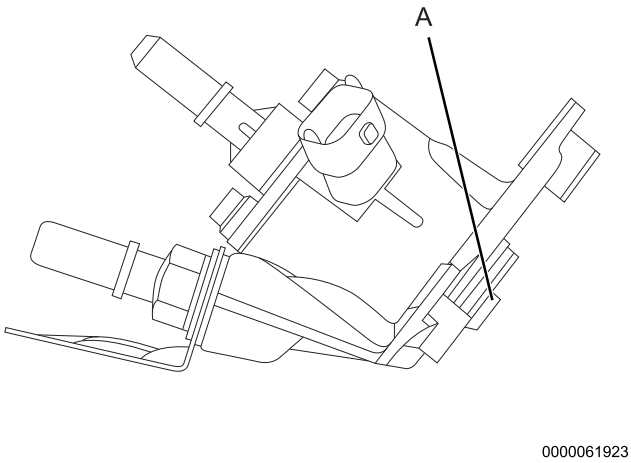


Figure 1077 Diesel Exhaust Fluid Dosing Unit (DEF: DU) Tip

A. DEF Dosing Unit tip

1. Inspect Diesel Exhaust Fluid Dosing Unit (DEF: DU) (Figure 1077) (Item A) tip for DEF deposits.

- If DEF deposits are found, the DEF: DU must be cleaned. Follow cleaning procedure in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*
- If DEF: DU tip is free of DEF deposits, go to next step.

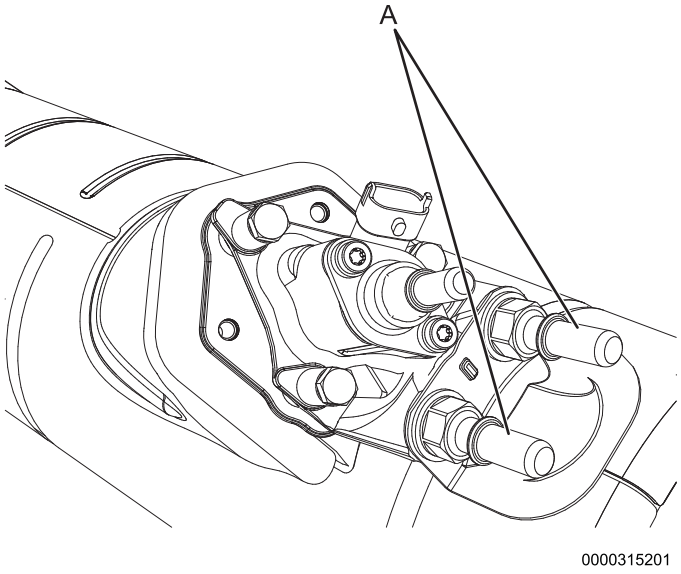


Figure 1078 DEF: DU Coolant Passages

A. DEF: DU coolant passages

2. Check that DEF: DU coolant passages (Figure 1078) (Item A) are clean.

- If DEF: DU coolant passages need to be cleaned, follow cleaning procedure in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*
- If DEF: DU coolant passages are clean, go to Decomposition Reactor Tube Inspection (Decomposition Reactor Tube Inspection, page 2380).

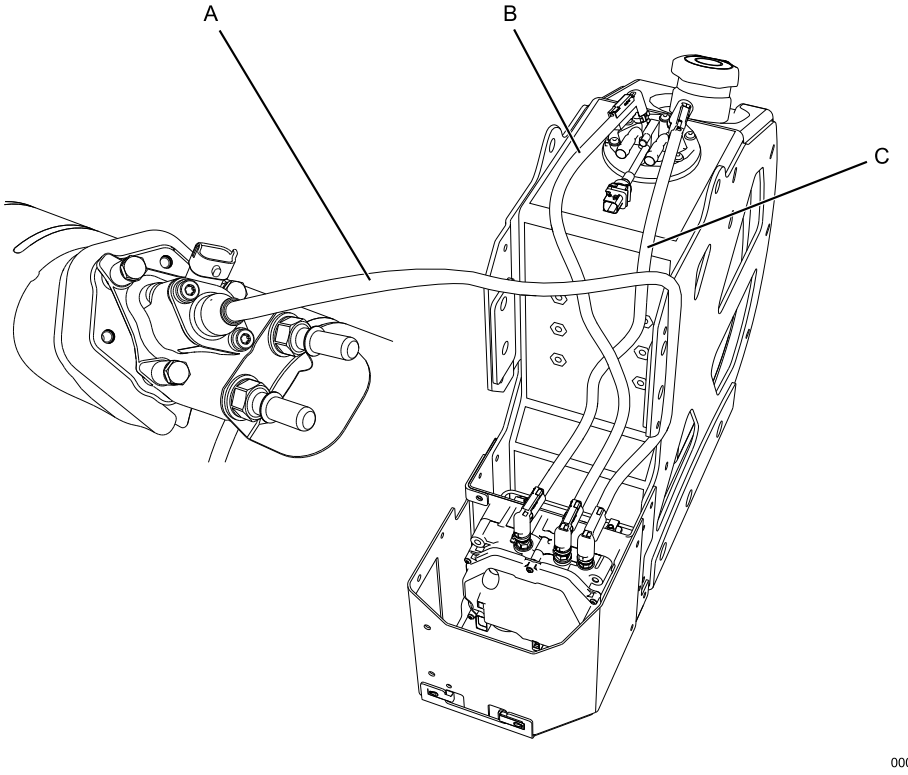


Figure 1079 DEF Pressure, Suction and Return Lines

A. DEF pressure line B. DEF return line C. DEF suction line

3. Visually inspect DEF pressure line (Figure 1079) (Item A), DEF suction line (Figure 1079) (Item C), and DEF return line (Figure 1079) (Item B) for leaks, kinks, bends, or other damage.

Expected Outcome

DEF: DU tip should be free of DEF deposits and coolant passages should be clean.

Decomposition Reactor Tube Inspection

Overview

Inspect decomposition reactor tube for blockage caused by Diesel Exhaust Fluid (DEF) deposits.

Tools Required

None

Equipment Condition

None

Inspection Procedure

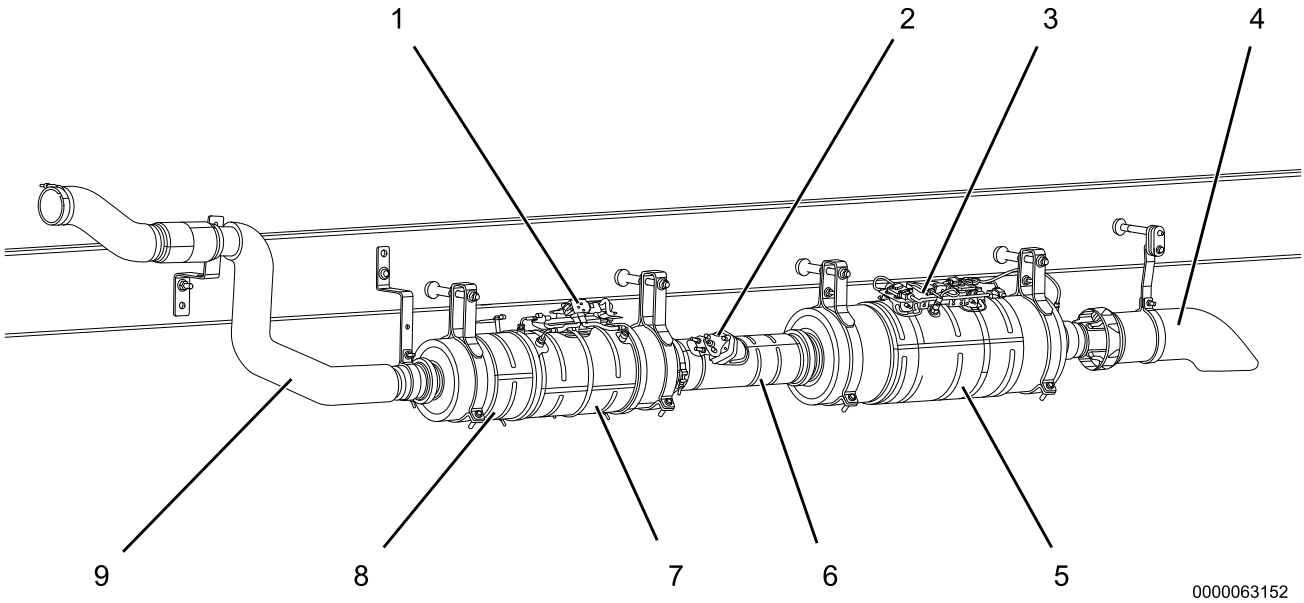


Figure 1080 In-Line Exhaust System

1. Diesel Particulate Filter (DPF) interface module
2. DEF Dosing Unit
3. Selective Catalyst Reduction (SCR) interface module
4. Tailpipe
5. Selective Catalyst Reduction (SCR) canister
6. Decomposition reactor tube
7. Diesel Particulate Filter (DPF)
8. Diesel Oxidation Catalyst (DOC)
9. Turbo pipe

1. Inspect decomposition reactor tube for blockage caused by Diesel Exhaust Fluid (DEF) deposits.
   - If the DEF deposits in the mixer area are blocking more than 50% of the decomposition reactor tube, the decomposition reactor tube must be cleaned.
2. Inspect the exhaust flanges for corrosion or other damage.
3. Follow cleaning procedure in the *Exhaust Aftertreatment System with DPF and SCR Service Manual.*

Expected Outcome

Decomposition reactor tube should be free from blockage caused by Diesel Exhaust Fluid (DEF) deposits.

Diesel Exhaust Fluid (DEF) Quality Inspection

Overview

Inspect Diesel Exhaust Fluid (DEF) for contamination and proper urea concentration.

WARNING: To prevent personal injury or death, avoid contact with Diesel Exhaust Fluid (DEF) / urea. Do not get DEF in eyes. In case of eye contact, immediately flush eyes with large amounts of water for a minimum of 15 minutes. Do not swallow. If DEF is ingested, contact a physician immediately.

Tools Required

- Diesel Exhaust Fluid (DEF) Refractometer 5025

Equipment Condition

None

Inspection Procedure

1. Obtain sample of Diesel Exhaust Fluid (DEF).
2. Visually inspect for contamination.
3. Use DEF Refractometer 5025 to test urea concentration of DEF.

Expected Outcome

Diesel Exhaust Fluid (DEF) should be free of contamination and urea concentration should be 32.5% +/- 1.5%.

Diesel Exhaust Fluid (DEF) Level & Gauge Inspection

Overview

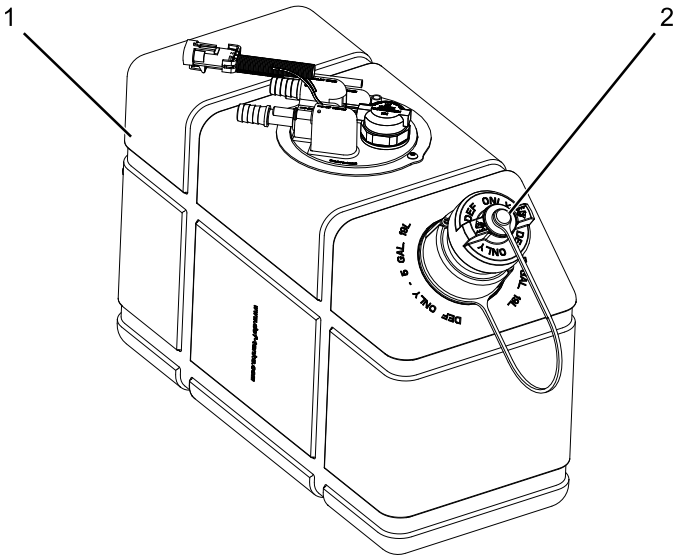
Determine the approximate level of Diesel Exhaust Fluid (DEF) in the DEF tank and operation of the DEF level gauge.

Tools Required

None

Equipment Condition

1. Park vehicle on level ground.
2. Key-On Engine-Off (KOEO).



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Figure 1081 Diesel Exhaust Fluid (DEF) Tank

1. DEF tank
2. DEF cap

3. Remove DEF cap (Figure 1081) (Item 2).
4. Remove DEF fill neck.

Inspection Procedure

1. Use shop light or flashlight to check DEF level in tank related to tank volume. Example: 1/4 full, 1/2 full.
2. Compare DEF tank level to gauge reading.
3. DEF level should be roughly equivalent to amount shown on DEF level Gauge.

Expected Outcome

Diesel Exhaust Fluid (DEF) in DEF tank should be close to the level indicated on the DEF level gauge.

Coolant to Oil Sump Inspection

Overview

Inspect oil in oil pan for coolant contamination.

NOTE: Oil cooler coolant leakage to oil will occur only when coolant pressure is higher than oil pressure. Diagnosis and repairs will not be authorized based solely on oil analysis.

Tools Required

None

Inspection Procedure

1. Inspect for crankcase being overfilled.
2. Remove drain plug from oil pan and drain oil to obtain an oil sample.
3. Inspect oil sample for signs of coolant. Contaminated oil will have a light-gray or black sludgy appearance. If crankcase is over-full, this is also a sign of coolant to lube oil contamination.

Expected Outcome

Oil is not contaminated with coolant.

Oil Pressure Regulator Inspection

Overview

Check oil pressure regulator for damage, binding, or sticking.

Tools Required

None

Equipment Condition

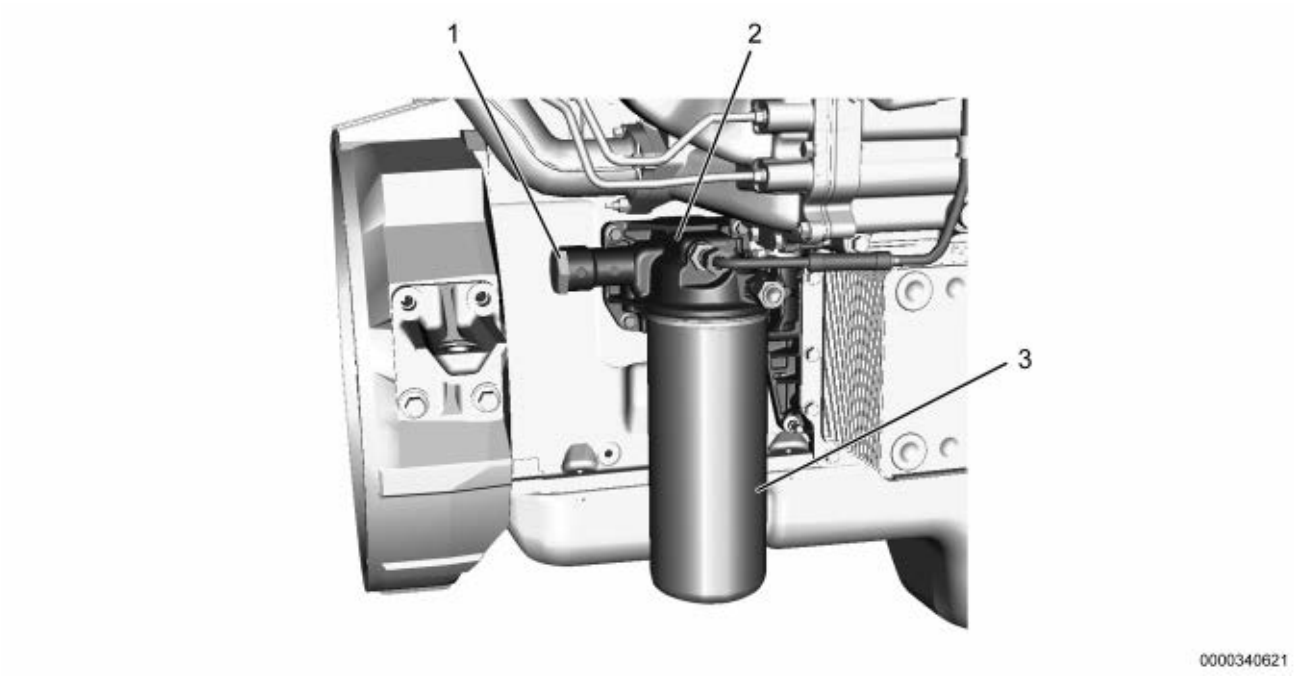
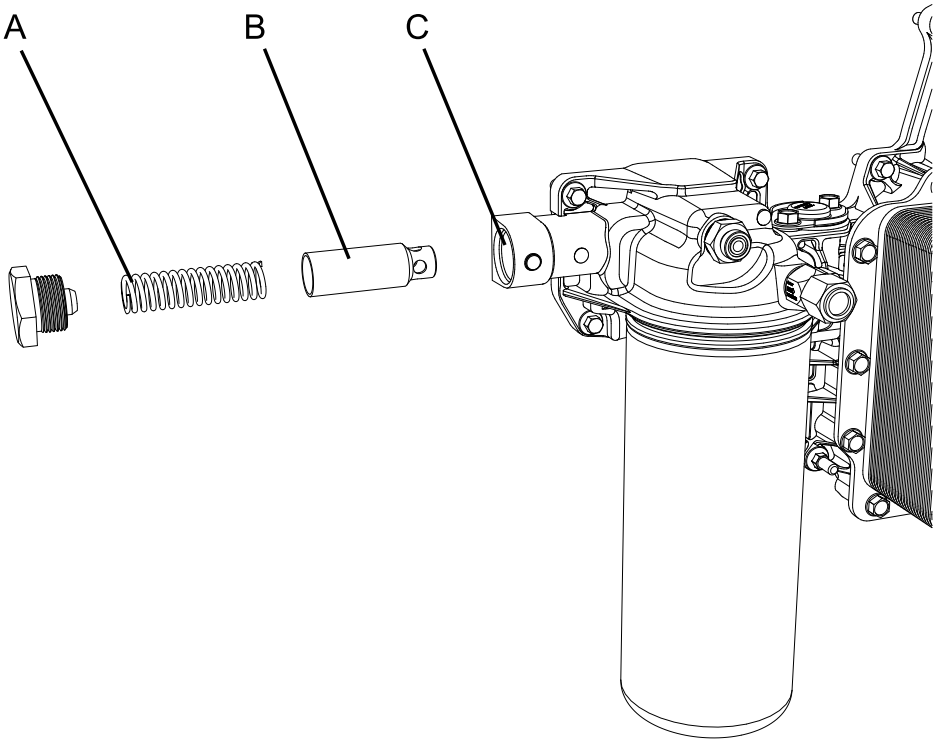


Figure 1082 Oil Filter / Oil Filter Housing Assembly

1. Oil filter regulator
2. Oil filter housing
3. Oil filter

1. Remove regulator valve spring and piston (see *Engine Service Manual*).

Inspection Procedure



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Figure 1083 Oil Pressure Regulator

A. Regulator valve spring B. Regulator piston C. Bore

1. Check regulator valve spring (Figure 1083) (Item A) for collapsed, damaged, and broken coils.
2. Check regulator piston (Figure 1083) (Item B) and bore (Figure 1083) (Item C) for scoring.

Expected Outcome

Oil pressure regulator will have no broken parts, will not bind or stick, and surfaces will show no signs of scoring or excessive wear.

Cylinder Sleeve Cavitation and Crack Inspection

Overview

Inspect cylinder sleeves for holes or cracks caused by cavitation (gas-filled bubbles formed in the coolant).

Tools Required

None

Equipment Condition

Remove cylinder head. See *Engine Service Manual*.

Inspection Procedure

1. Inspect piston crowns for signs of coolant leaks. Lack of carbon indicates possible coolant leak into the cylinder.
2. Bar engine over until pistons 1 and 6 are at Bottom Dead Center (BDC). Visually inspect cylinder sleeve for cracks or holes.
3. Inspect cylinder sleeves 1 and 6 for possible cavitation leaks and/or cracks.
4. Repeat for cylinders pairs 2-5 and 3-4.
5. Repair as needed.

Expected Outcome

Carbon deposits should be present on piston crowns, indicating cylinder sleeves are free of holes and cracks.

Oil and Crankcase Inspection

Overview

The goal of this inspection is to inspect for internal components leaking larger than normal amounts of oil or damaged internal parts.

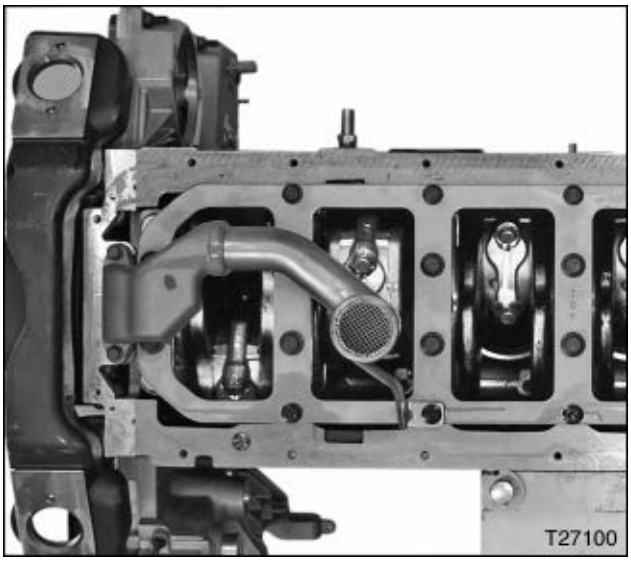
Tools Required

- Regulator assembly

Equipment Condition

1. Oil drained.
2. Oil pan removed (see *Engine Service Manual*).

Inspection Procedure



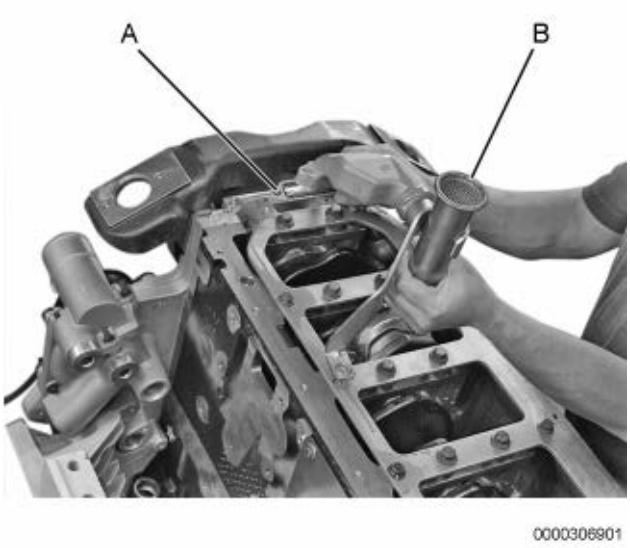


Figure 1085 Oil Pump Pick-up Tube

A. Oil Pump Pick-up Tube Gasket
B. Oil Pump Pick-up Tube

1. Remove oil pump pick-up tube (Figure 1085) (Item B).
2. Check tube and gasket (Figure 1085) (Item A).

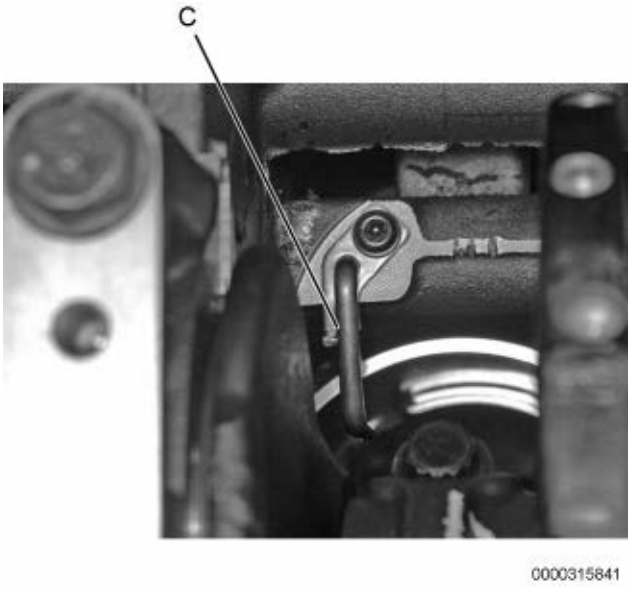


Figure 1086 Piston

3. Check for missing or broken piston cooling jets (Figure 1086) (Item C).
4. Use regulated shop air to check for loose bearings, cam bushings, or excessive flow from regulator valve return port.

Expected Outcome

No internal engine damage or excessive engine lube oil leaking will be found.

High-Pressure (HP) Turbocharger Radial Play Inspection

Overview

Check High-Pressure (HP) Turbocharger for excessive radial play.

Tools Required

None

Equipment Condition

Remove compressor housing from High Pressure (HP) Turbocharger.

Inspection Procedure

1. Inspect high pressure turbocharger compressor housing and compressor wheel for signs of contact including damage to the compressor wheel and/or scaring to the compressor housing.

Expected Outcome

High-Pressure (HP) Turbocharger compressor wheel does not have excessive play, and does not contact the inside of the compressor wheel housing, and is free from damage.

Batteries and Electrical System Inspection

Overview

Inspect batteries, electrical system, and connections to help identify corroded connections, voltage drops, verify proper battery voltage, and identify damaged electrical connections and components.

WARNING: To prevent personal injury or death, disconnect the main battery negative terminal before disconnecting or connecting electrical components. Always connect ground cable last.

WARNING: To prevent personal injury or death when working with batteries, always wear face or eye protection, have water supply available, assure good ventilation, and be sure no flames or sparks are present.

Tools Required

- Digital Multi-Meter (DMM)
- Flash light (optional)
- Battery charger

Equipment Condition

None

Inspection Procedure

1. Inspect batteries and battery connections. If connections are corroded, loose, or damaged; clean and reinstall battery connections. If batteries are cracked or damaged replace as necessary.
2. If applicable, check batteries electrolyte level. If electrolyte is below the top of the plates in one or more cells, add distilled water.
3. Inspect electrical system for damaged electrical components or wiring, and loose connections (including engine grounds and starter connections). Repair damaged or loose components or connections.
4. Measure voltage of batteries. If voltage is less than 12.6 volts, charge batteries, and test charging system.

Expected Outcome

Batteries, wiring, electrical connections, and electrical components are clean, connections are tight, and not damaged. Batteries voltage 12.6-15 volts.

Aftertreatment

Snap Acceleration Test

Overview

This test is used to check the Diesel Particulate Filter (DPF) for cracks or internal damage without removing it from vehicle. The test checks for basic functionality of the DPF and should be done prior to removing it.

Tools Required

None

Equipment Condition

None

Test Setup

None

Test Procedure

1. The transmission must be in neutral and the parking brake applied.
2. Start and idle the engine.
3. Rapidly snap the accelerator to full throttle (this can be done multiple times).
4. During the engine accelerations, visually monitor the exhaust pipe for heavy black smoke. Use assistant if necessary.

Expected Outcome

There will not be heavy clouds of black smoke exiting the exhaust pipe. Black smoke is an indication of a failure in the Aftertreatment (AFT) system, specifically the DPF.

Follow-On Procedure

None

Downstream Injection System Operation Test

Overview

This test uses a special tool and a system test to determine if a faulty downstream injector is due to an electronic control malfunction and/or wiring or a Downstream Injection (DSI) Assembly fault. Separating the command circuit and DSI Assembly allows for proper diagnosis of the Downstream Injection System.

CAUTION: Do NOT disconnect the Downstream Injection (DSI) Assembly harnesses or plug in the NOID Light with the Key ON. Doing so will give false test results, resulting in improper diagnosis and unnecessary repairs.

Tools Required

- Electronic Service Tool (EST) with ServiceMaxx™ software
- Interface cable (RP1210B compliant supporting J1939 and J1708)
- NOID Light – 15-909-01

Equipment Condition

None

Test Setup

1. Connect Electronic Service Tool (EST) to vehicle diagnostic connector(page 2124).
2. Log into ServiceMaxx™.
3. Key OFF.

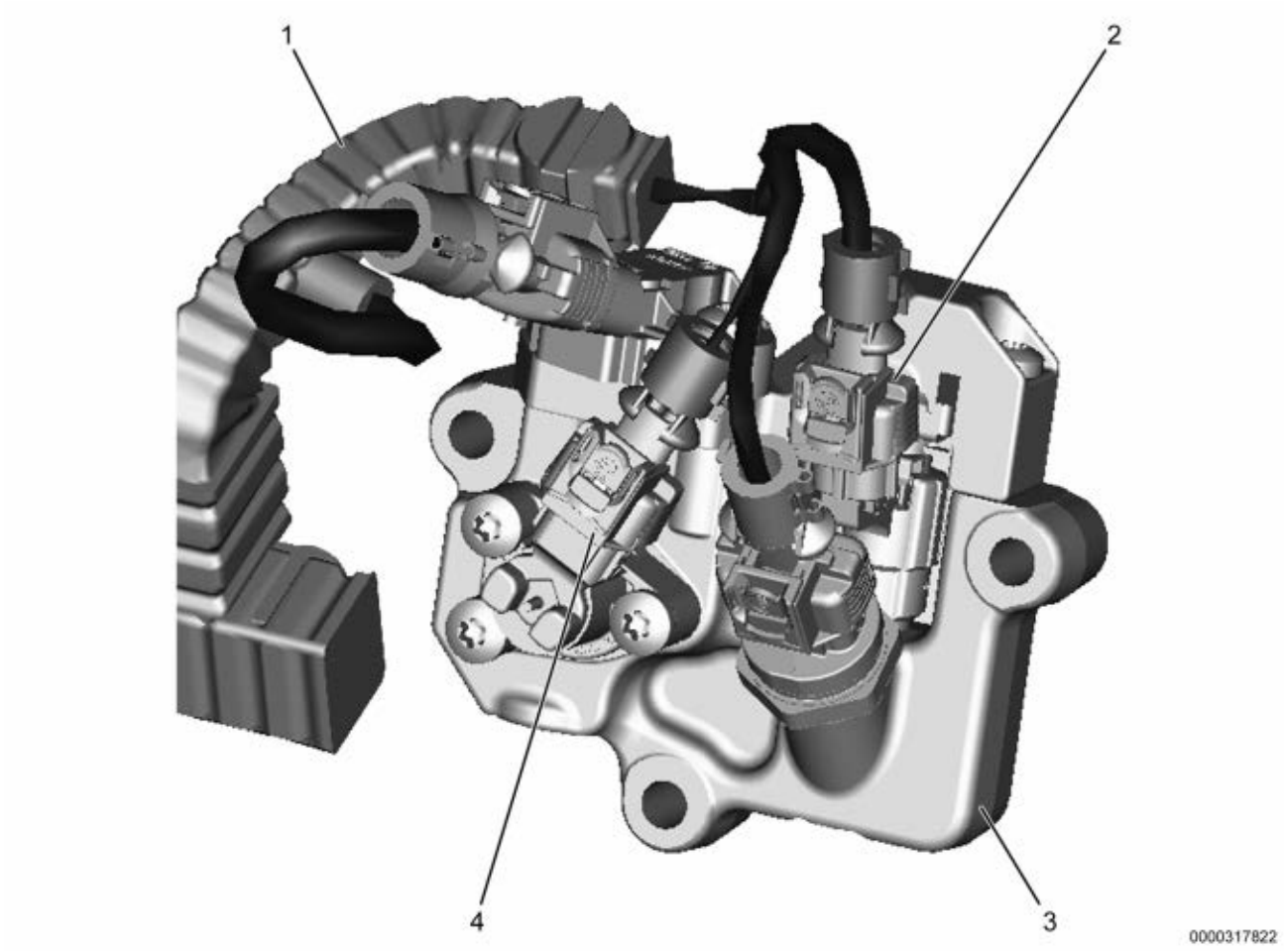


Figure 1087 Downstream Injection (DSI) Assembly with Connectors

1. Engine wiring harness
2. Aftertreatment Fuel Pressure Control (AFT: FPC) Connector
3. Downstream Injection (DSI) Assembly
4. Aftertreatment Fuel Enable Control (AFT: FEC) Connector

4. Disconnect Aftertreatment Fuel Pressure Control (AFT: FPC) connector (Figure 1087) (Item 2) from Downstream Injection (DSI) Assembly (Figure 1087) (Item 3).
5. Plug NOID Light (15-909-01) into AFT: FPC harness.

Test Procedure

1. Key ON.
2. Use ServiceMaxx™ to perform the KOEO DCU Actuator Test(page 2156).
   - Select Tests > KOEO Aftertreatment Tests > Actuator - DCU Actuators.
   - In the drop down menu select "AFT Fuel Pressure CTL".
   - Ensure "On (95% Duty Cycle)" is selected.

- Click "Start Test".

3. Observe NOID Light during test.
   - Steady on or Flashing light indicates the electrical control and wiring for the DSI Assembly is working properly.
   - No light indicates an electrical circuit or control fault.
4. If light indicates a properly functioning command circuit and control for AFT: FPC (Figure 1088) (Item 2), turn Key OFF.

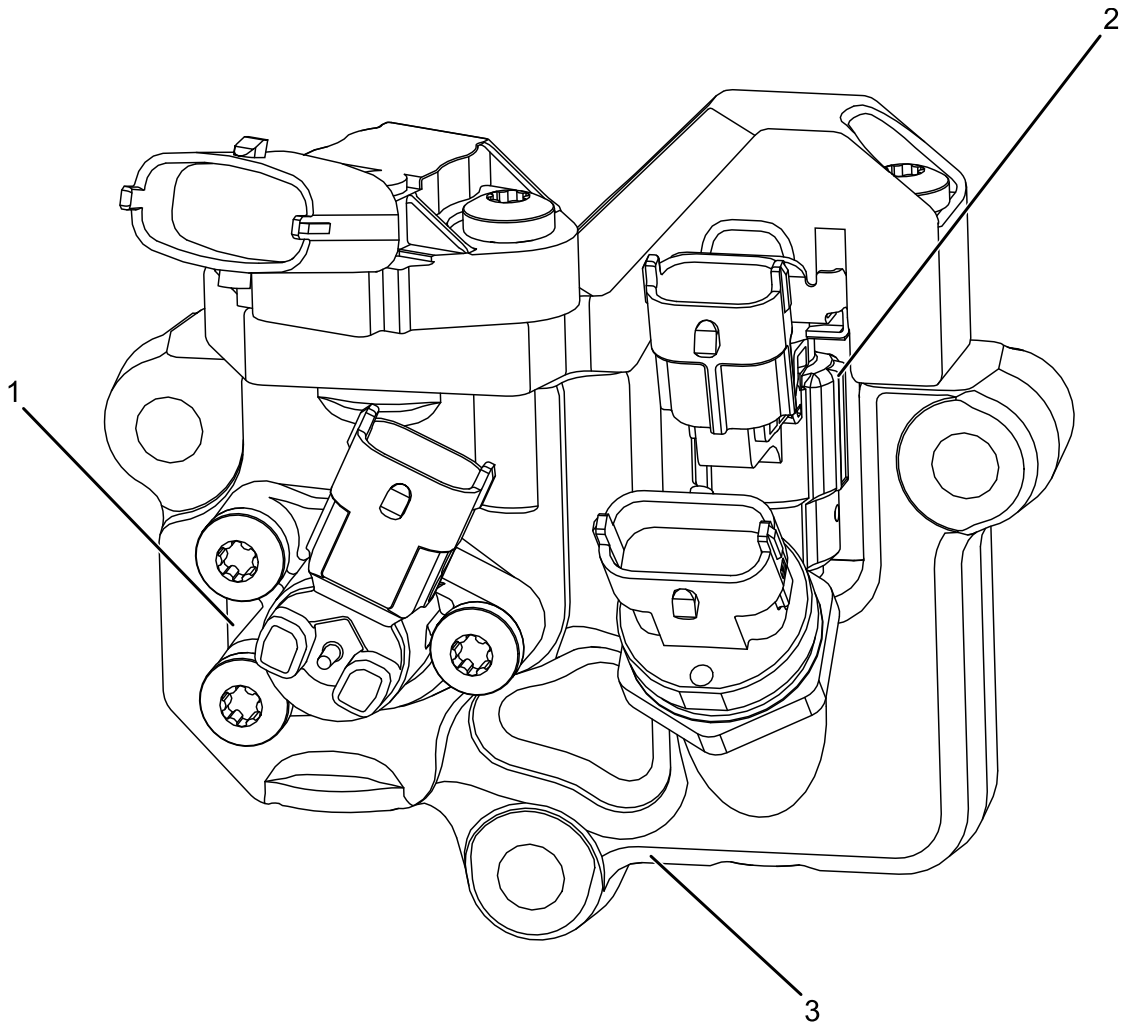


Figure 1088 Downstream Injector (DSI) Assembly

1. Aftertreatment Fuel Enable Control (AFT: FEC)
2. Aftertreatment Fuel Pressure Control (AFT: FPC)
3. Downstream Injection (DSI) Assembly

5. Unplug NOID Light, and plug AFT: FPC connector back into DSI Assembly (Figure 1088)(Item 2).

6. Unplug Aftertreatment Fuel Enable Control (AFT: FEC) connector from the DSI Assembly (Figure 1087) (Item 4).
7. Plug NOID Light into AFT: FEC harness.
8. Key ON.
9. Use ServiceMaxx™ to perform the KOEO DCU Actuator Test(page 2156).
    - Select Tests > KOEO Aftertreatment Tests > Actuator - DCU Actuators.
    - In the drop down menu select "AFT Fuel Enable CTL".
    - Ensure "On" is selected.
    - Click "Start Test".
10. Observe NOID Light during test.
    - Steady on or Flashing light indicates the electrical control and wiring for the DSI Assembly is working properly.
    - No light indicates an electrical circuit or control fault.

Expected Outcome

NOID Light will indicate if command signals and wiring are working properly for the Downstream Injection (DSI) Assembly.

Follow-on Procedure

None

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All Ratings

Position Sensors

Engine Specifications

Navistar® 9, and 10 Diesel Engines	
Engine configuration	4 stroke, inline six cylinder diesel
Navistar® 9 and 10 displacement	570 in^3 (9.3 L)
Bore (sleeve diameter)	4.59 in (116.6 mm)
Stroke	
• Navistar® 9 and 10	5.75 in (146 mm)
Compression ratio	
• Navistar® 9 and 10	17.2 : 1
Aspiration	Two-Stage Turbocharger, Intercooler and Aftercooler
Advertised brake horsepower @ rpm	See EPA exhaust emission label
Peak torque @ rpm	See EPA exhaust emission label
Engine rotation (facing flywheel)	Counterclockwise
Combustion system	Direct injection turbocharged
Fuel system	Electro-hydraulic injection
Total engine weight (oil and accessories)	
• Navistar® 9 and 10	1,870 lbs (848 kg)
Cooling system capacity (engine only)	13.5 qts US (12.8 L)
Lube system capacity (including filter)	30 qts US (28 L)
Lube system capacity (overhaul only, with filter)	34 qts US (32 L)
Firing order	1-5-3-6-2-4

Key-On Engine-Off

Key-On Engine-Off

Barometric Absolute Pressure	See Local Weather Conditions
Engine Compression Brake Pressure (if applicable)	0.15 to 0.35 volt
Engine oil pressure (2010 Emissions Model Year)	-3.0 to 3.0 psi (-20.68 to 20.68 kPa)
Engine oil pressure (2013 Emissions Model Year)	-2.34 to 2.34 psi (-16.10 to 16.10 kPa)
Exhaust back pressure	-1.38 to 1.38 psi (-9.49 to 9.49 kPa)
Diesel Particulate Filter Differential Pressure (DPFDP)	0.47 to 0.91 volt
Injection Control Pressure (ICP)	0.15 to 0.35 volt
Intake Manifold Pressure (IMP)	-1.38 to 1.38 psi (-9.49 to 9.49 kPa)
Fuel delivery pressure (2010 Emissions Model Year) Fuel delivery pressure (2013 Emissions Model Year) Fuel pump OFF, pressure bled down	-1.38 to 1.38 psi (-9.49 to 9.49 kPa) -2.34 to 2.34 psi (-16.10 to 16.10 kPa)
Fuel delivery pressure with fuel pump on and using a mechanical gauge.	70 to 100 psi (483 to 689 kPa)
Turbocharger 1 Turbine Outlet Pressure (TC1TOP)	0 kPa (0 psi) / 0.72 V with fuel pump off

Position Sensors

Key-On Engine-Off

Accelerator Pedal Position 1 (APP1) (Not Depressed)	0 % Nominal
Accelerator Pedal Position 2(APP2) (Not Depressed)	0 % Nominal
Accelerator Pedal Position 1 (APP1) (Not Depressed)	1.10 volt Nominal
Accelerator Pedal Position 1 (APP1) (Not Depressed)	0.56 volt Nominal
Accelerator Pedal Position 1 (APP1) (Fully Depressed)	100 % Nominal
Accelerator Pedal Position 2 (APP2) (Fully Depressed)	100 % Nominal
Accelerator Pedal Position 1 (APP1) (Fully Depressed)	4.30 volt Nominal
Accelerator Pedal Position 2 (APP2) (Fully Depressed)	2.14 volt Nominal
EGR Valve Control	35 to 90%
EGR Position	35 to 90%
Engine Throttle Position	0 % Nominal

Engine Cranking Specs

Engine Cranking

Cranking rpm (min)	130 rpm
20 seconds maximum crank time per attempt. Wait 2 to 3 minutes before repeating.	
Battery voltage (min based on ECM drop out)	9 V
Injection control pressure (min to start engine)	5 MPa (725 psi) / 0.95 V
EGR control	35 %
Fuel delivery pressure with fuel pump on and using a mechanical gauge.	70 to 100 psi (483 to 689 kPa)

Low Idle, No Load, Stabilized Engine Operating Temperature Specs

Temperature Sensors

Low Idle, no load, stabilized engine operating temperature

Engine coolant temperature (at thermostat opening)	85 °C (185 °F) ± 2.78 °C (5 °F)
	1.26 V ± 0.4 V
Engine oil temperature should not go 5.5 °C (10 °F) above engine coolant temperature.	
Intake Manifold Temperature	66 °C (150 °F) ± 5.5 °C (10 °F)

Pressure - check with sensor and mechanical gauge

Low Idle, no load, stabilized engine operating temperature

Engine oil pressure (min with gauge)	214 kPa (31 psi) / 2.19 V
Fuel delivery pressure (gauge)	621 kPa (90 psi) ± 10 psi

High Idle, No Load, Stabilized Engine Operating Temperature Specs

High Idle, Parasitic load, at stabilized operating temperature

Fuel delivery pressure (gauge)	621 kPa (90 psi) ± 10 psi

Crankcase Pressure

High idle no load - max. using ZTSE4039	1.5 kPa (6 in. H_2O)

Full Load, Rated Speed on Dynamometer, Stabilized Engine Operating Temperature Specs

Full Load, Rated Speed on Dynamometer, Stabilized Engine Operating Temperature

Air cleaner restriction (max)	6.2 kPa (25 in H_2O)
Fuel delivery pressure (gauge)	621 kPa (90 psi) ± 10 psi
Mass air flow sensor	4612 Hz (min)
	8138 Hz (max)

Engine Coolant Temperatures ECT1, ECT2, Engine Oil Temp, Intake Manifold Temp (IMAT) Specs

Temperature Sensor (ECT)	
Temperature at -18 °C (0 °F)	4.62 V / 247 kΩ
Temperature at 0 °C (32 °F)	4.37 V / 96 kΩ
Temperature at 21 °C (70 °F)	3.78 V / 36 kΩ
Temperature at 65 °C (150 °F)	1.93 V / 6.3 kΩ
Temperature at 93 °C (200 °F)	0.99 V / 2.6 kΩ
Temperature Sensor (EOT)	
Temperature at -18 °C (0 °F)	4.62 V / 247 kΩ
Temperature at 0 °C (32 °F)	4.37 V / 96 kΩ
Temperature at 21 °C (70 °F)	3.78 V / 36 kΩ
Temperature at 65 °C (150 °F)	1.93 V / 6.3 kΩ
Temperature at 93 °C (200 °F)	0.99 V / 2.6 kΩ
Temperature Sensor (IMT)	
Temperature at -18 °C (0 °F)	4.64 V / 269 kΩ
Temperature at 0 °C (32 °F)	4.40 V / 99 kΩ
Temperature at 21 °C (70 °F)	3.80 V / 36 kΩ
Temperature at 65 °C (150 °F)	1.89 V / 6.2 kΩ
Temperature at 93 °C (200 °F)	0.99 V / 2.5 kΩ

Intake Air Temp (IAT) Specs

Temperature Sensor (AIT)	
Temperature at -18 °C (0 °F)	4.44 V / 250 kΩ
Temperature at 0 °C (32 °F)	3.87 V / 95.8 kΩ
Temperature at 21 °C (70 °F)	2.82 V / 35.9 kΩ
Temperature at 65 °C (150 °F)	0.908 V / 6.335 Ω

Diesel Oxidation Catalyst Intake Temp (DOCIT), Diesel Particulate Filter Intake Temp (DPFIT), Diesel Particulate Outlet Temp (DPFOT) Specs

Temperature Sensors (DOCIT, DPFIT, DPFOT)	
Temperature at 21 °C (70 °F)	4.5 V / 19.4 Ω
Temperature at 65 °C (150 °F)	3.9 V / 7.1 Ω
Temperature at 93 °C (200 °F)	3.4 V / 4.3 Ω
Temperature at 204 °C (400 °F)	1.6 V / 0.96 Ω
Temperature at 482 °C (900 °F)	0.34 V / 0.146 Ω

Soot Load Level versus Exhaust Gas Target Temperature Chart

Overview

This chart shows target exhaust gas temperatures at various soot loads in the Diesel Particulate Filter (DPF). This chart is for reference only and requires other tests and analysis to be performed in order to use it properly.

Soot Load Level versus Exhaust Gas Target Temperature Chart

DPF Soot Load (%)	Exhaust Gas Target Temperature (DPFIT)	DTC
0 - 50	1067°F (575°C)	No DTC
62.5	1044.5°F (562.5°C)	
75	1022°F (550°C)	
87.5	999.5°F (537.5°C)	
100	977°F (525°C)	
112.5	963.5°F (517.5°C)	
125	950°F (510°C)	
137.5	936.5°F (502.5°C)	
150	923°F (495°C)	
164	909.5°F (487°C)	
182	896°F (480°C)	SPN 3251 FMI 15
200	896°F (480°C)	SPN 3251 FMI 16
236.8	896°F (480°C)	
250	896°F (480°C)	SPN 3251 FMI 0

Other Components Specs

Other Components	
CMP sensor	850 Ω
CKP sensor	420 Ω ± 140 Ω
Injector coil	0.575 Ω ± 0.575 Ω

Navistar® 9 (9.3L)

300 hp @ 2000 rpm (12NWC)

Navistar® 9/300 hp @ 2000 rpm / 860 ft•lb @ 1200 rpm	
Engine unit code	12NWC
Engine model	Navistar® 9/300
Engine Family Rating Code (EFRC)	5131
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	227 kPa (33 psi)
Exhaust back pressure	393 kPa (57 psi)
Injection control pressure	29 MPa (4206 psi)

EGR Control	35% to 80%
Engine Throttle Position	0%

315 hp @ 2000 rpm (12NWD)

Navistar® 9/315 hp @ 2000 rpm / 950 ft•lb @ 1200 rpm	
Engine unit code	12NWD
Engine model	Navistar® 9/315
Engine Family Rating Code (EFRC)	5151
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	231 kPa (33 psi)
Exhaust back pressure	400 kPa (58 psi)
Injection control pressure	31 MPa (4496 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%

330 hp @ 2000 rpm (12NWE)

Navistar® 9/330 hp @ 2000 rpm / 950 ft•lb @ 1200 rpm	
Engine unit code	12NWE
Engine model	Navistar® 9/330
Engine Family Rating Code (EFRC)	6131
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	233 kPa (33 psi)
Exhaust back pressure	403 kPa (59 psi)
Injection control pressure	31 MPa (4496 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%

Navistar® 10 (9.3L)

310 hp @ 2000 rpm (12NWG)

Navistar® 10/310 hp @ 2000 rpm / 1050 ft•lb @ 1200 rpm	
Engine unit code	12NWG
Engine model	Navistar® 10/310
Engine Family Rating Code (EFRC)	5141
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	229 kPa (33 psi)
Exhaust back pressure	396 kPa (58 psi)
Injection control pressure	30 MPa (4351 psi)

EGR Control	35% to 80%
Engine Throttle Position	0%

330 hp @ 2000 rpm (12NWH)

Navistar® 10/330 hp @ 2000 rpm / 1150 ft•lb @ 1200 rpm	
Engine unit code	12NWH
Engine model	Navistar® 10/330
Engine Family Rating Code (EFRC)	6141
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	233 kPa (33 psi)
Exhaust back pressure	403 kPa (59 psi)
Injection control pressure	31 MPa (4496 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%

350 hp @ 2000 rpm (12NWJ)

Navistar® 10/350 hp @ 2000 rpm / 1150 ft•lb @ 1200 rpm	
Engine unit code	12NUZ
Engine model	Navistar® 10/350
Engine Family Rating Code (EFRC)	6151
Injection timing	Nonadjustable
High idle speed - manual transmission	2400 rpm
High idle speed - automatic transmission	2400 rpm
Low idle speed	700 rpm
Low Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	0 kPa (0 psi)
Exhaust back pressure	4 kPa (0.6 psi)
Injection control pressure	6 MPa (853 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
High Idle, no load, stabilized engine operating temperature	
Intake manifold pressure	54 kPa (8 psi)
Exhaust back pressure	151 kPa (22 psi)
Injection control pressure	11 MPa (1595 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%
Torque converter stall (automatic transmission)	1900 rpm or greater @ 5 seconds or less
Full load, ECM rated speed at highway, stabilized engine operating temperature	
Intake manifold pressure	237 kPa (34 psi)
Exhaust back pressure	410 kPa (60 psi)
Injection control pressure	31 MPa (4554 psi)
EGR Control	35% to 80%
Engine Throttle Position	0%

Fluids

Fluid Specifications and Info

Fuel

See engine *Operator's* and *Maintenance Manual*.

Ultra Low Sulfur Diesel (ULSD)

See engine *Operator's* and *Maintenance Manual*.

The American Petroleum Institute (API) Diesel Pump Label is compliant with Environmental Protection Agency (EPA) CFR 80.570.

Ultra Low Sulfur Diesel (ULSD) fuel is required for all Navistar® and MaxxForce® engines with advanced aftertreatment systems. The fuel should meet all the specifications of American Society for Testing and Materials (ASTM) D975 standard (current year revision), including the EPA specification for sulfur content (0.0015 % mass or 15 ppm maximum). These specifications are included in the standard under the designation No. 2-D S15 fuel and No. 1-D S15 fuel. Grade No. 1-D fuel is a lighter fuel with higher volatility than grade No. 2-D; it may be blended with grade No. 2-D in wintertime to provide engine operability under low ambient temperature.

Acceptable Fuel Blends

Navistar® Inc. approves of blends up to B5, provided that the two components satisfy current specifications. Quality biodiesel blends up to B5 should not cause engine or fuel system problems.

Use of Higher Biodiesel Fuel Blends (B6 to B20)

Standard ASTM D7467-08 covers the specifications for blends between 6% and 20% (B6 to B20). These blends may be used in vehicles that operate in populated areas or in fleets which are required to use alternative fuels to reduce urban pollution.

Use of B6 to B20 blends is at the discretion of the customer / operator and will not automatically void an engine warranty. However, if engine component failure can be directly attributable to use of a B6 to B20 blend not provided by a BQ9000 certified fuel supplier or not meeting the ASTM D7467-08 Standard, Navistar® may, at its option, deny warranty on the affected engine or engine component.

WARNING: To prevent personal injury or death, do not mix gasoline, gasohol, or alcohol with diesel fuel. An open heat source, spark, cell phone or electronic device can ignite these fuel mixtures. This creates a fire hazard and possible explosion.

CAUTION: To prevent engine damage, do not mix propane with diesel fuel. Navistar® will not honor warranty claims against engines that have used propane.

Engine Lubrication Oil

See engine *Operator's* and *Maintenance Manual*.

Program: I-746	Quarts	Liters	
Total oil fill capacity including filter (subject to change)	30	28.5	per build level: HT ISC-Retrofit

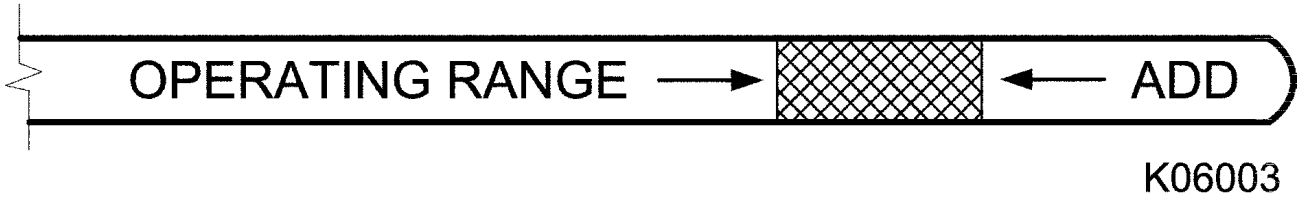
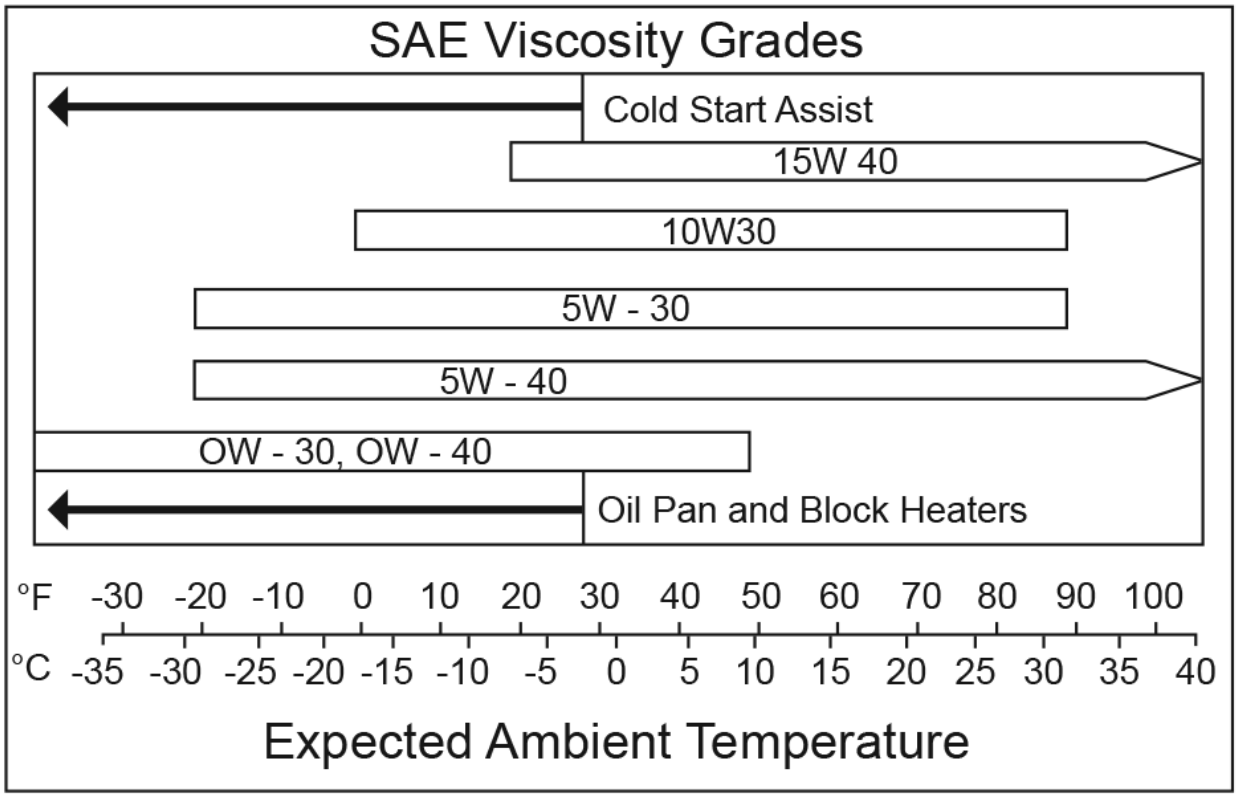


Figure 1089 Oil Level Gauge (Typical)

If oil level is below operating range, fill with recommended oil for operating climate. The ADD mark indicates 3 quarts US (2.8 liters) of oil should be added.

API CJ-4 oil, in combination with Ultra Low Sulfur Diesel (ULSD) fuel [0.0015% (15 ppm) maximum sulfur content], is recommended to maintain performance and durability of aftertreatment systems meeting 2007 and beyond diesel emission regulations.

SAE Oil Viscosity Grades and Temperature Ranges



The Society of Automotive Engineers (SAE) defines oil viscosity (thickness) by grade. Colder temperatures require lower grade oils for correct flow during starting. Higher temperatures require higher grade oils for satisfactory lubrication.

- An oil pan and block coolant heater is required for temperatures below 10 °F (-12 °C).
- For heavy duty driving or trailer towing, higher oil grades 15W-40 and 5W-40 oils are required, if temperatures are over 50 °F (10 °C).

API classification CI-4 or later for 15W-40: above 10°F (-12°C), and below 10°F (-12°C).

Coolant

Cooling System Capacity

Cooling system refill capacities vary considerably due to variations in chassis, body options, and in addition to the amount of coolant remaining in the system after draining. Total capacity may range from 6 to 22 gallons (23 to 83 liters).

Coolant Mixtures

Extended Life Coolant (ELC) 50/50 Premix is the standard factory fill for the cooling system. ELC 50/50 Premix is used to replenish coolant loss and ensure that glycol / water concentrations stay in balance. If a customer wishes to use a conventional (non-OAT ELC) coolant, it should minimally meet ASTM D6210, Standard Specification for fully - Formulated Glycol Base Engine Coolant for Heavy Duty Engines.

Freeze Point Protection Levels Concentrate (ethylene glycol) and Water Mixtures	
Concentrate and Water Mixtures	**Freeze Point Protection**
40% concentrate and 60% water	-12 °F (-24.4 °C)
50% concentrate and 50% water	-34 °F (-36.7 °C)
60% concentrate and 40% water	-62 °F (-52.2 °C)
67% concentrate and 33% water	-95 °F (-70.6 °C)

For vehicles operating in extremely cold climates, a coolant mixture of 60% Concentrate and 40% water or 67% Concentrate and 33% water provide freeze protection as shown in previous table. Mixtures having more than 67% Concentrate are not recommended.

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Electrical Tools

Breakout Harness 18-050-01 (20-way DEF Harness Interconnect)



Figure 1091 18-050-01

Breakout Harness 18-050-01 is used to measure voltage and resistance on circuits that pass through the 20-way Diesel Exhaust Fluid (DEF) harness interconnect.

Breakout Harness 18-650-01 (Ammonia (NH_3) Sensor)



Figure 1092 18-650-01

Breakout Harness 18-801-01 (Ammonia (NH_3) Sensor Module)



Figure 1093 18-801-01

Breakout Harness 18-801-01 is used to measure voltage and resistance on circuits that go to the Ammonia (NH3) Sensor Module.

Breakout Harness 18-909-01 (DEF Supply Module)



Figure 1094 18-909-01

Breakout Harness 18-909-01 is used to measure voltage and resistance on circuits that go to the Diesel Exhaust Fluid (DEF) Supply Module.

Breakout Harness 18-047-01 DEF Line 3 Heater (Pressure)



Figure 1095 18-047-01

Breakout Harness 18-047-01 is used to measure voltage and resistance on circuits that go to the Diesel Exhaust Fluid DEF Line 3 Heater (Pressure).

Breakout Harness 18-046-01 DEF Line 2 Heater (Return)



Figure 1096 18-046-01

Breakout Harness 18-046-01 is used to measure voltage and resistance on circuits that go to the Diesel Exhaust Fluid (DEF) Line 2 Heater (Return).

Breakout Harness 18-045-01 DEF Line 1 Heater (Supply)



Figure 1097 18-045-01

Breakout Harness 18-045-01 is used to measure voltage and resistance on circuits that go to the Diesel Exhaust Fluid (DEF) Line 1 Heater (Supply).

Breakout Harness 18-124-01 (DEF Tank Level and Temperature Sensor)



Figure 1098 18-124-01

Breakout Harness 18-124-01 is used to measure voltage and resistance on circuits that go to the Diesel Exhaust Fluid (DEF) Tank Level and Temperature Sensor.

Breakout Harness 18-649-01 (NOx Out and DOC / DPF Temperature Sensor Module)



Figure 1099 18-649-01

Breakout Harness 18-649-01 is used to measure voltage and resistance on circuits that go to the Carbon Monoxide (NOx) Out and Diesel Oxidation Catalyst / Diesel Particulate Filter (DOC / DPF) temperature sensor module.

Breakout Harness 12-575-01 (DPF Differential Pressure / Outlet Pressure Sensor)



Figure 1100 12-575-01

Breakout Harness 12-575-01 is used to measure voltage and resistance on circuits that go to the Diesel Particle Filter (DPF) Differential Pressure / Outlet Pressure Sensor.

Breakout Harness 18-648-01 (NOx In Sensor Module and SCR Temperature Sensor Module)



Figure 1101 18-648-01

Breakout Harness 18-648-01 is used to measure voltage and resistance on circuits that go to the Carbon Monoxide (NOx) In sensor module and Selective Catalyst Reduction (SCR) temperature sensor module.

Breakout Harness 12-574-01 (8-way DPF Jumper Harness)



Figure 1102 12-574-01

Breakout Harness 12-574-01 is used to measure voltage and resistance on circuits that pass through the 8-way Diesel Particle Filter (DPF) Jumper Harness.

Breakout Harness 18-250-01 (12-way SCR Jumper Harness)



Figure 1103 18-250-01

Breakout Harness 18-250-01 is used to measure voltage and resistance on circuits that pass through the 12-way Selective Catalyst Reduction (SCR) Jumper Harness.

Breakout Harness 18-500-01 (12-way AFT Interconnect)



Figure 1104 18-500-01

Breakout Harness 18-500-01 is used to measure voltage and resistance on circuits that pass through the 12-way Aftertreatment (AFT) interconnect.

Digital Multimeter (DMM) ZTSE4357



Figure 1105 ZTSE4357

The DMM ZTSE4357 is used to troubleshoot electrical components, sensors, injector solenoids, relays, and wiring harnesses. The DMM has a high input impedance that allows testing of sensors while the engine is running without loading the circuit being tested. This ensures the signal voltage measurement will not be affected by the voltmeter.

Breakout Harness ZTSE6023 (EFP)



Figure 1106 ZTSE6023

Breakout Harness ZTSE6023 is used to measure voltage and resistance on circuits that go to the Electronic Fuel Pump (EFP).

International® Electronic Engine Terminal Test Kit ZTSE4435C



Figure 1107 ZTSE4435C

The International® Electronic Engine Terminal Test Kit ZTSE4435C is used to access circuits in the connector harness and allows for the use of a Digital Multimeter (DMM) without damaging the harness connectors. The probes may also be used as a guide to determine whether the harness connector is retaining correct tension on the mating terminal.

Breakout Harness ZTSE4485A (APP)

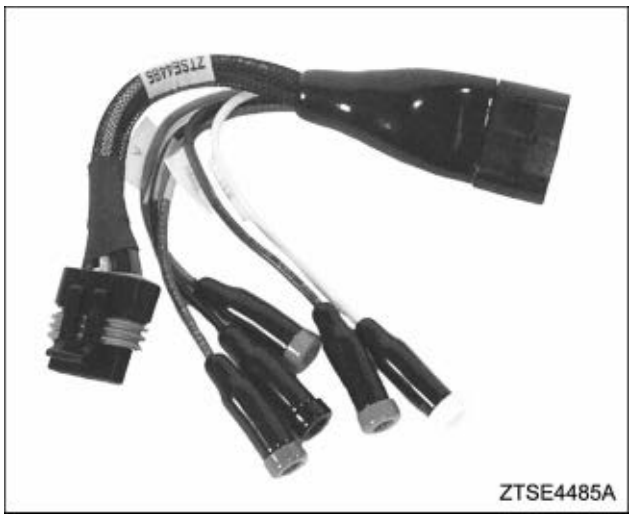


Figure 1108 ZTSE4485A

Breakout Harness ZTSE4485A is used to measure voltage and resistance on circuits that go to the Accelerator Pedal Position (APP) sensor.

Breakout Harness ZTSE4760A (DOCIT, DPFIT, and DPFOT)

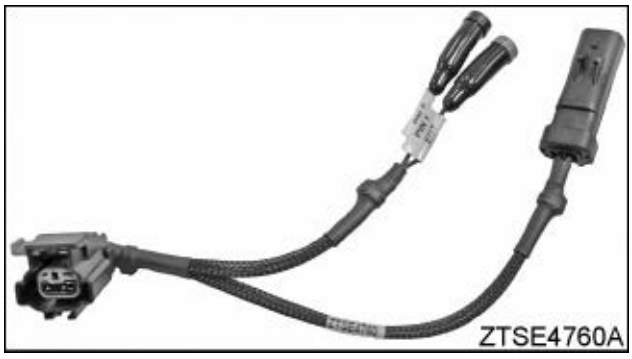


Figure 1109 ZTSE4760A

Breakout Harness ZTSE4760A is used to measure voltage and resistance on circuits that go to the Diesel Oxidation Catalyst Intake Temperature (DOCIT), Diesel Particulate Filter Intake Temperature (DPFIT), and Diesel Particulate Filter Outlet Temperature (DPFOT) sensors.

Breakout Harness ZTSE4735A (ETV)



Figure 1110 ZTSE4735A

Breakout Harness ZTSE4735A is used to measure voltage and resistance on circuits connected to the Engine Throttle Valve (ETV).

Amp Clamp ZTSE4575

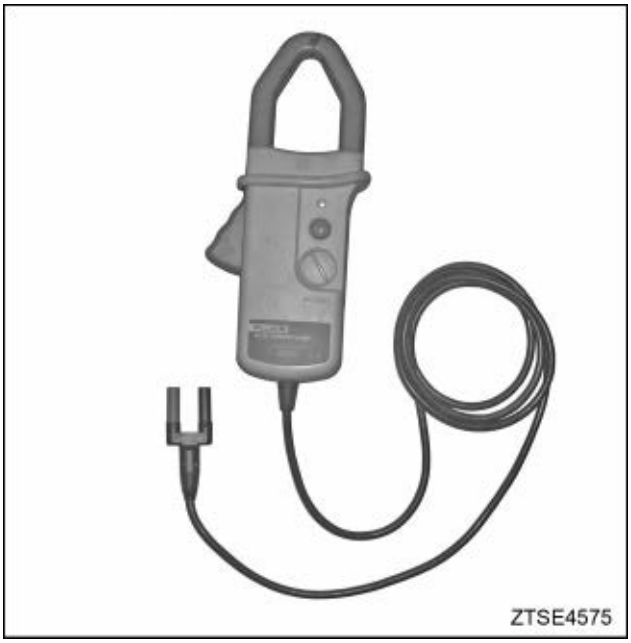


Figure 1111 ZTSE4575

The Amp Clamp ZTSE4575 is used to measure amperage draw for the Intake Air Heater (IAH).

3-Banana Plug Harness ZTSE4498

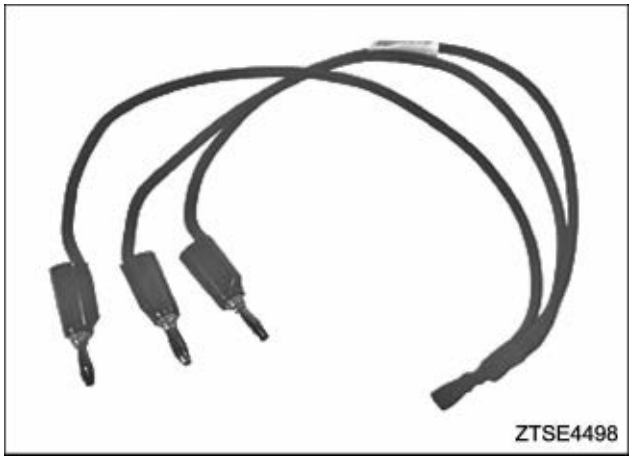


Figure 1112 ZTSE4498

The 3-Banana Plug Harness ZTSE4498 is used for sensor-end diagnostics of sensor circuits.

500-Ohm Resistor Harness ZTSE4497



Figure 1113 ZTSE4497

The 500-Ohm Resistor Harness ZTSE4497 is used for sensor-end diagnostics of sensor circuits, and for performing loaded circuit tests.

Breakout Harness ZTSE4484 (IPR)

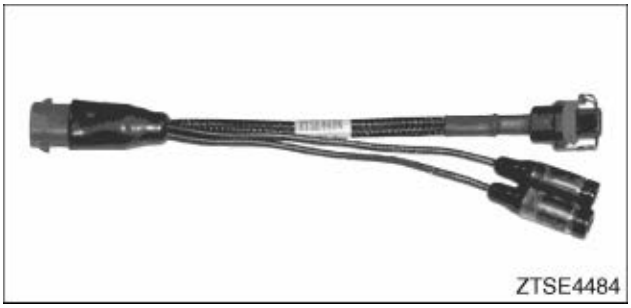


Figure 1114 ZTSE4484

Breakout Harness ZTSE4484 is used to measure the voltage and resistance on circuits that go to the Engine Injection Control Pressure Regulator (IPR).

Breakout Harness ZTSE4602 (EOT, ECT1, and AFTFSV)

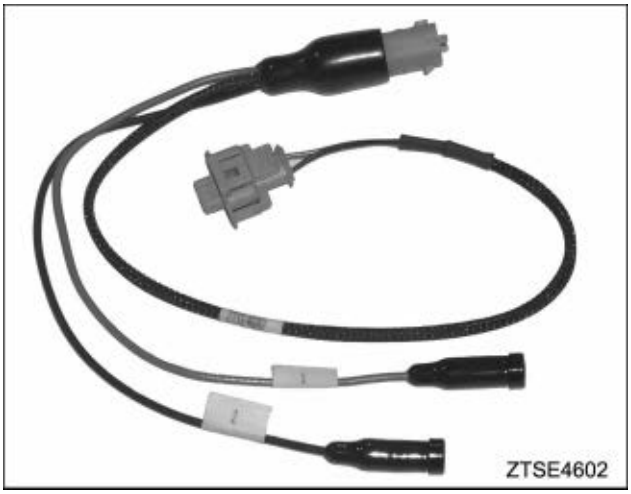


Figure 1115 ZTSE4602

Breakout Harness ZTSE4602 is used to measure voltage and resistance on circuits that go to the Engine Oil Temperature (EOT), Engine Coolant Temperature 1 (ECT1), and Aftertreatment Fuel Shutoff Valve (AFTFSV).

Breakout Harness ZTSE4674 (ECM and ACT PWR Relays)



Figure 1116 ZTSE4674

Breakout Harness ZTSE4674 is used to measure voltage and resistance on circuits that go to the Engine Control Module (ECM) and Actuator (ACT) PWR relays.

Breakout Harness ZTSE4830 (AFTFIS)

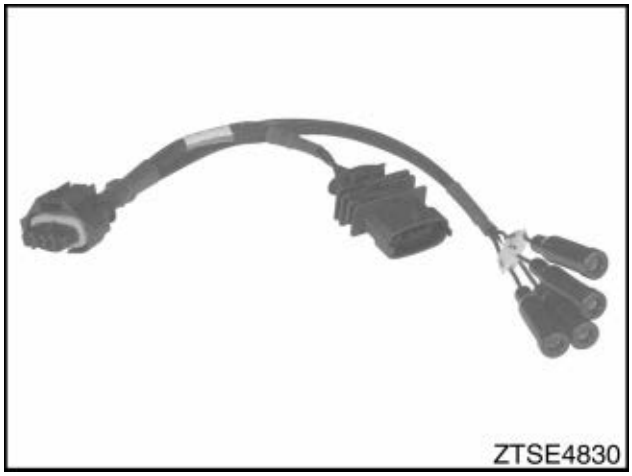


Figure 1117 ZTSE4830

Breakout Harness ZTSE4830 is used to measure voltage and resistance on circuits connected to the Aftertreatment Fuel Intake Sensor (AFTFIS).

Breakout Harness ZTSE4831 (TC2WG)



Figure 1118 ZTSE4831

Breakout Harness ZTSE4831 is used to measure voltage and resistance on circuits connected to the Turbocharger 2 Wastegate Control Actuator (TC2WG).

Breakout Harness ZTSE4834 (EBPV)

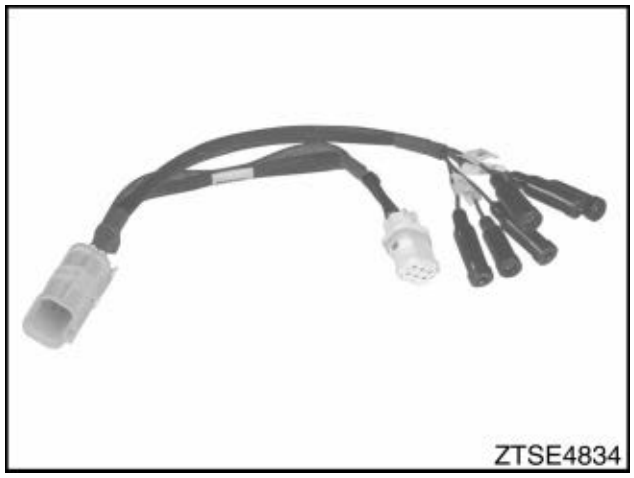


Figure 1119 ZTSE4834

Breakout Harness ZTSE4834 is used to measure voltage and resistance on circuits connected to the Exhaust Back Pressure Valve (EBPV).

Breakout Harness ZTSE4850 (IMP, ICP, EOP, FDP, and EBP)

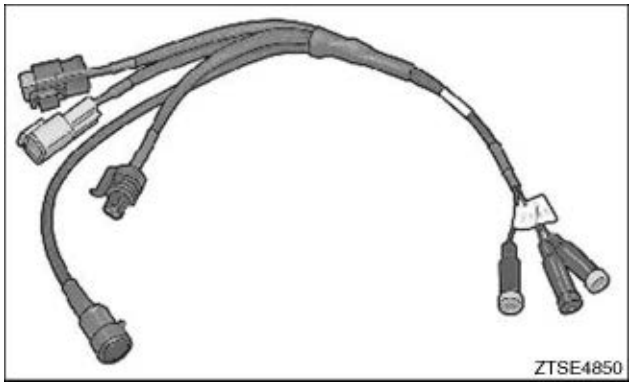


Figure 1120 ZTSE4850

Breakout Harness ZTSE4850 is used to measure voltage and resistance on circuits connected to the Intake Manifold Pressure (IMP), Injection Control Pressure (ICP), Engine Oil Pressure (EOP), Fuel Delivery Pressure (FDP), and Exhaust Back Pressure (EBP) sensors.

Breakout Harness ZTSE4908 (EFAN)

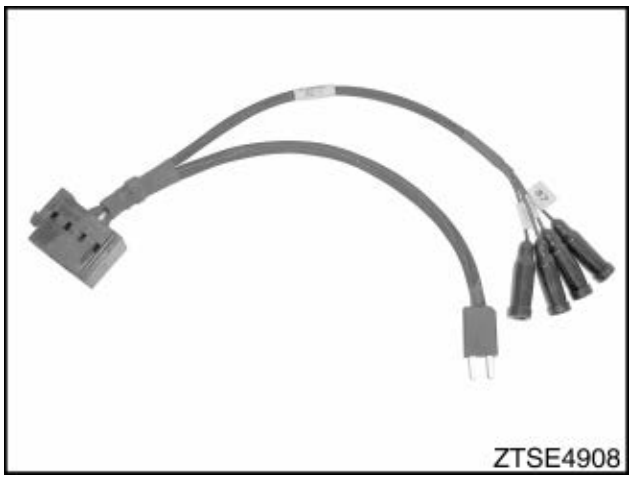


Figure 1121 ZTSE4908

Breakout Harness ZTSE4908 is used to measure voltage and resistance on circuits to the Starter Relay and Engine Fan (EFAN) relay.

Breakout Harness ZTSE4946 (EGT)



Figure 1122 ZTSE4946

Breakout Harness ZTSE4946 enables the technician to quickly connect a voltmeter and read voltage signals for the Exhaust Gas Temperature (EGT) sensor.

Breakout Harness ZTSE4948 (EGR)



Figure 1123 ZTSE4948

Breakout Harness ZTSE4948 is used to measure voltage and resistance on circuits that go to the Exhaust Gas Recirculation (EGR) valve.

Breakout Harness ZTSE4950 (CKP)



Figure 1124 ZTSE4950

Breakout Harness ZTSE4950 is used to measure voltage and resistance on circuits connected to the Crankshaft Position (CKP) sensor.

Breakout Harness ZTSE4951 (CMP)

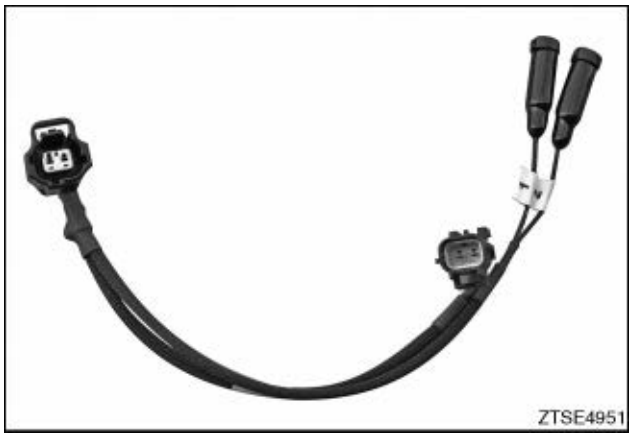


Figure 1125 ZTSE4951

Breakout Harness ZTSE4951 is used to measure voltage and resistance on circuits connected to the Camshaft Position (CMP) sensor and the Crankcase Oil Separator Speed (CCOSS) sensor.

Breakout Harness ZTSE4952 (ICP, ECB, and ECBP)



Figure 1126 ZTSE4952

Breakout Harness ZTSE4952 is used to measure continuity of the Injection Control Pressure (ICP) sensor, Engine Compression Brake (ECB), and the Engine Compression Brake Pressure (ECBP) sensor.

Breakout Harness ZTSE4993 (IMT)

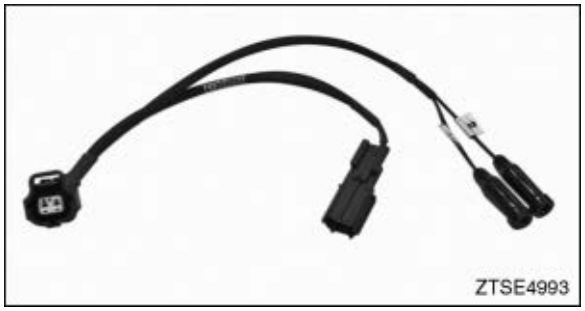


Figure 1127 ZTSE4993

Breakout Harness ZTSE4993 is used to measure voltage and resistance on circuits that go to the Intake Manifold Temperature (IMT), Charge Air Cooler Outlet Temperature (CACOT) Sensor and High Pressure Turbo Intake Temperature (HPCIT) sensor.

Breakout Harness ZTSE6002 (WIF)

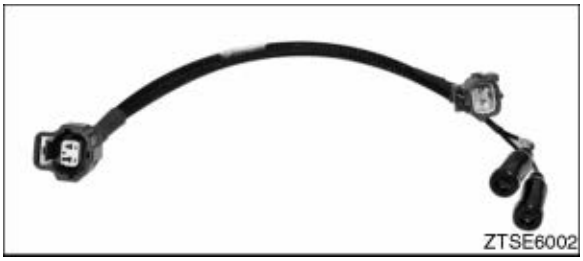


Figure 1128 ZTSE6002

Breakout Harness ZTSE6002 is used to measure voltage and resistance on circuits that go to the Water In Fuel (WIF) sensor.

Breakout Harness ZTSE6020 (24-pin)

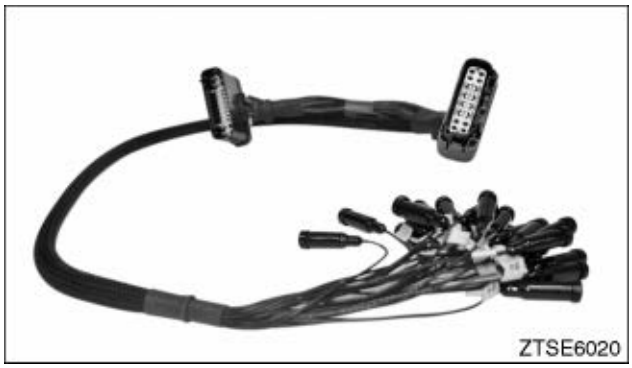


Figure 1129 ZTSE6020

Breakout Harness ZTSE6020 is used to measure voltage and resistance on circuits that go to the 24-pin Engine / IP connector.

Breakout Harness ZTSE6021 (AFTFD)

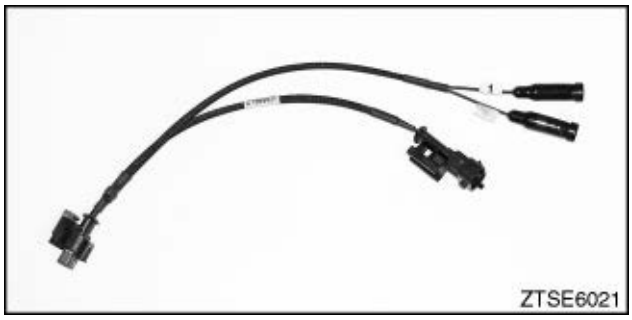


Figure 1130 ZTSE6021

Breakout Harness ZTSE6021 is used to measure voltage and resistance on circuits connected to the Aftertreatment Fuel Doser (AFTFD).

Breakout Harness ZTSE6025 (IAH)



Figure 1131 ZTSE6025

Breakout Harness ZTSE6025 is used to measure voltage and resistance on circuits that go to the Intake Air Heater (IAH) relay.

Breakout Harness ZTSE6027 (AFTFP)



Figure 1132 ZTSE6027

Breakout Harness ZTSE6027 is used to measure voltage and resistance on circuits that go to the Aftertreatment (AFT) Fuel Pressure (AFTFP) sensor.

Under Valve Cover (UVC) ZTSE4793

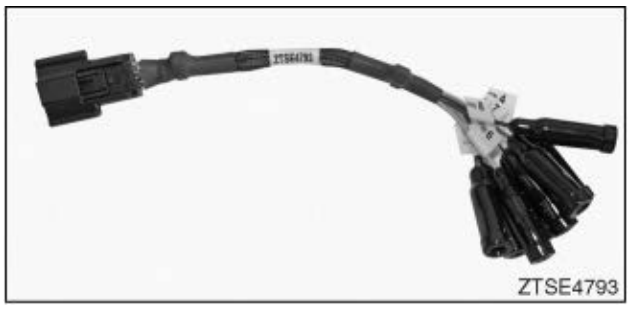


Figure 1133 ZTSE4793

UVC Wiring (for injector solenoids, ICP sensor, SCB sensor and Engine Compression Brake Pressure (ECBP) Sensor).

DEF Tank Heat Coolant Flow Valve ZTSE4827



Figure 1134 ZTSE4827

Diesel Exhaust Fluid Dosing Unit (DEFDU) ZTSE4828

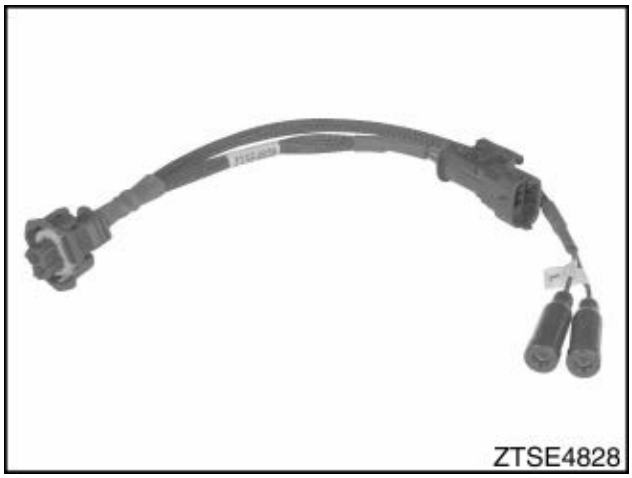


Figure 1135 ZTSE4828

Mass Air Flow (MAF) Sensor ZTSE4960



Figure 1136 ZTSE4960

Noid Lamp 15-909-01



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Mechanical Tools

Radiator Pressure Test Kit ZTSE2384

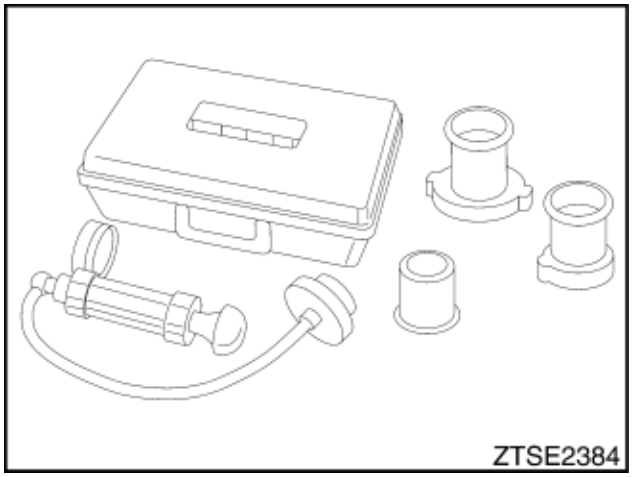


Figure 1138 ZTSE2384

The Radiator Pressure Test Kit ZTSE2384 is used to check pressure caps and cooling systems. The pressure gauge indicates if the pressure cap holds the correct pressure and whether the cooling system has leaks or holds pressure.

Pressure Test Kit ZTSE4409

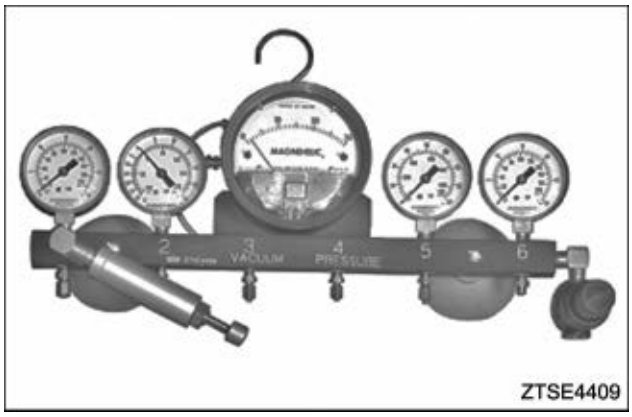


Figure 1139 ZTSE4409

The Pressure Test Kit ZTSE4409 is used to measure intake manifold (boost) pressure, fuel system intake restriction, fuel pressure, oil pressure, air cleaner intake restriction, and crankcase pressure.

- 0 to 200 kPa (0 to 30 psi) measures intake manifold pressure.

- 0-30 in Hg vacuum / 0 to 200 kPa (0 to 30 psi) compound gauge measures fuel system intake restriction and intake manifold pressure.

  0-30 in H_2O / 0 to 7.5 kPa (0 to 1 psi) maximum pressure magnehelic gauge measures crankcase pressure and air intake restriction.

- 60 to 1100 kPa (9 to 160 psi) gauge may be used to check the fuel pressure and oil pressure.

CAC Block Off Kit ZTSE4937

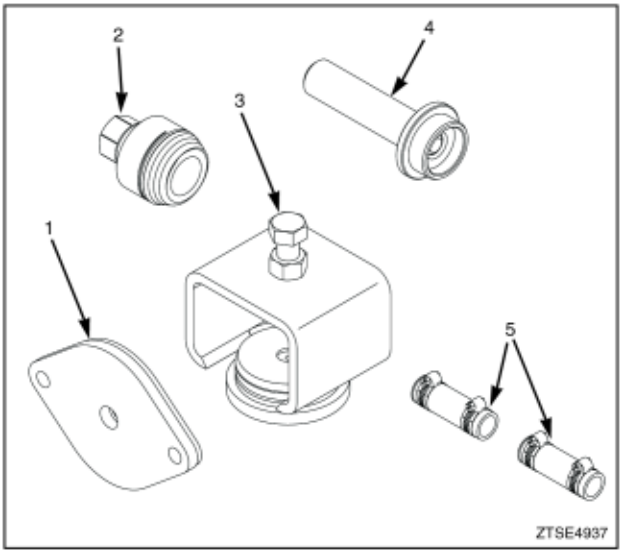


Figure 1140 ZTSE4937

1. Test plate
2. Seal remover
3. Test plug
4. Seal installer
5. Test cap

The CAC Block Off Kit ZTSE4937 is used to pressure test the interstage cooler (if available) and check for leaks.

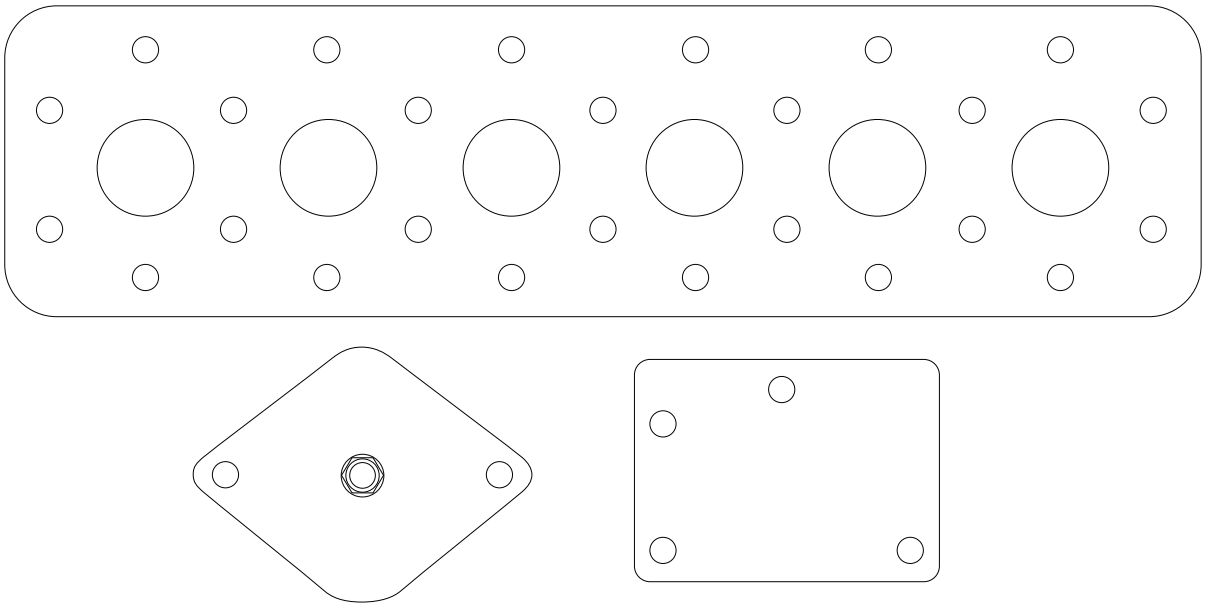
Oil Cooler Test Plate ZTSE4939



Figure 1141 ZTSE4939

The Oil Cooler Test Plate ZTSE4939 is used to test the integrity of the oil cooler.

Cylinder Head Pressure Test Adapter ZTSE4289A

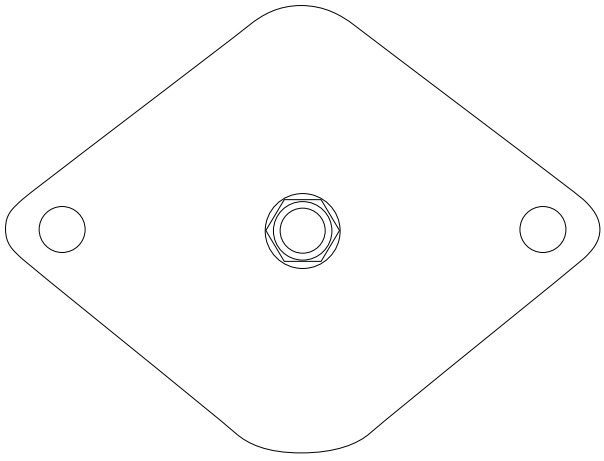


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Figure 1142 ZTSE4289A

The Cylinder Head Pressure Test Adapter ZTSE4289A kit includes cylinder head block-off plate, thermostat-opening block off plate, 0-30 psi gauge with pressure regulator and all necessary hardware.

Thermostat Opening Pressure Test Adapter ZTSE4647

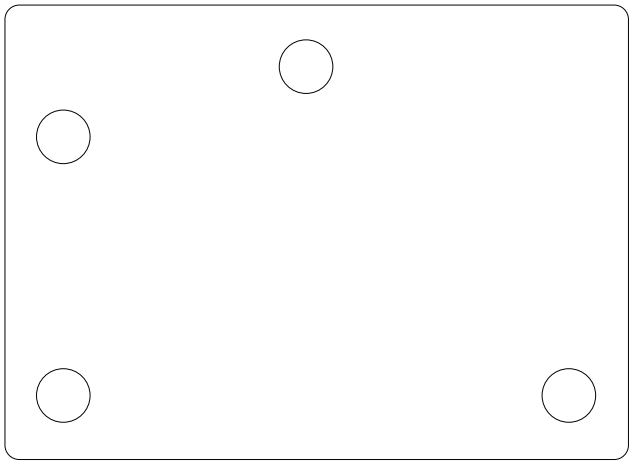


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Figure 1143 ZTSE4647

Thermostat Opening Pressure Test Adapter ZTSE4647 is used for pressure testing the cylinder head. Must be used in conjunction with ZTSE4648 and ZTSE4289a.

Water Supply Press Test Adapter ZTSE4648



0000310681

Figure 1144 ZTSE4648

The Water Supply Press Test Adapter ZTSE4648 is used for pressure testing the cylinder head. Must be used in conjunction with ZTSE4647 and ZTSE4289a.

ICP Adapter Pressure Test Fitting ZTSE4927



Figure 1145 ZTSE4927

The ICP Adapter Pressure Test Fitting ZTSE4927 is used with the High Pressure Test Gauge (ZTSE4954) to measure injection control pressure coming out of the high-pressure pump.

High Pressure Test Gauge ZTSE4954

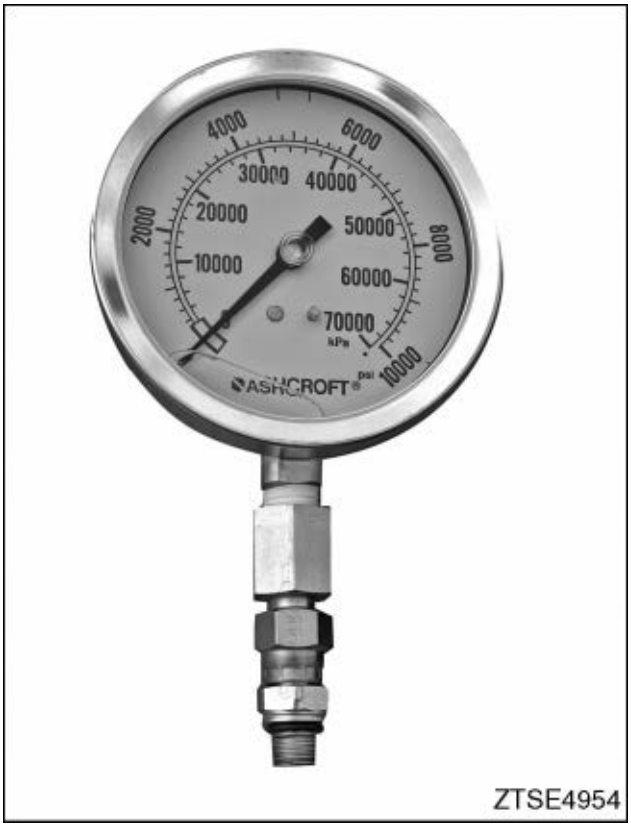


Figure 1146 ZTSE4954

The High Pressure Test Gauge ZTSE4954 is used with the ICP Adapter Pressure Test Fitting (ZTSE4927) to measure injection control pressure coming out of the high-pressure pump.

Pressure Gauge Adapter 18-538-01



0000290943

Figure 1147 18-538-010

Pressure Gauge Adapter 18-538-01 converts Aftertreatment (AFT) temperature sensor ports to 1/8-in NPT thread so a standard pressure gauge can be used to measure exhaust pressure.

IPR Plug Tester ZTSE4816

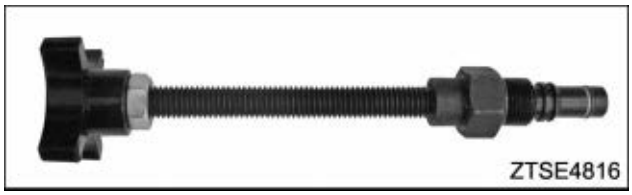


Figure 1148 ZTSE4816

The IPR Plug Tester ZTSE4816 is used to check the high-pressure pump for inability to reach maximum injection control pressure.

Crankcase Pressure Test Tool ZTSE4039

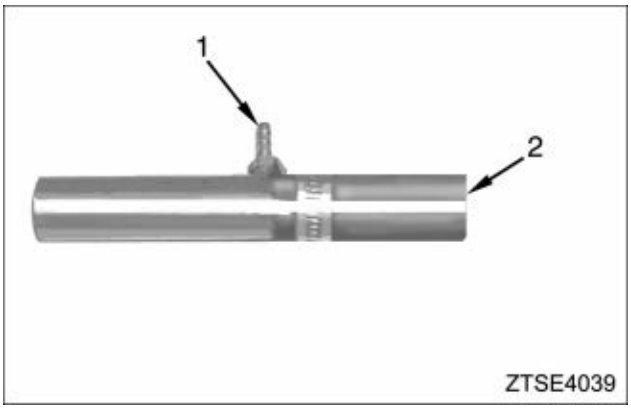


Figure 1149 ZTSE4039 (0.406 in. diameter)

1. To magnehelic gauge or manometer
2. To valve cover

The Crankcase Pressure Test Tool ZTSE4039 is used to measure combustion gas flow from the valve cover and may be used with the magnehelic gauge or Slack Tube® Manometer ZTSE2217A.

Use the pressure readings obtained with this adapter as the main source of engine condition. Use oil consumption trend data if the pressure readings are over the specified limits. Neither changes in oil consumption trends nor crankcase diagnostic pressure trends can establish a specific problem. These changes only indicate that a problem exists.

Slack Tube® Manometer ZTSE2217A

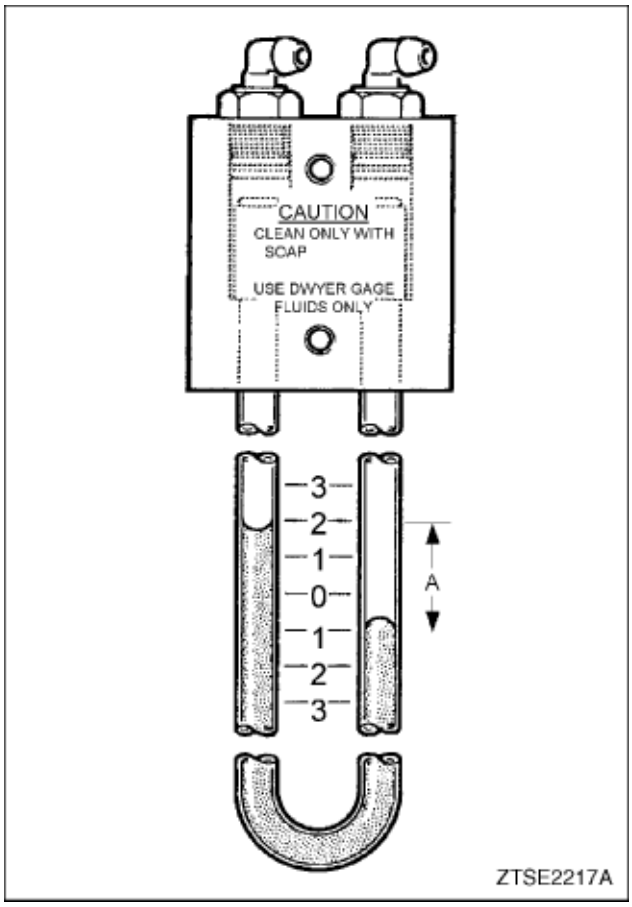


Figure 1150 ZTSE2217A

The Slack Tube® Manometer ZTSE2217A is a U-shaped tube with a scale mounted between the legs of the tube. When the portability of the Pressure Test Kit is not required, this manometer is used to measure low vacuum for intake restriction, low pressure for crankcase, or exhaust back pressure.

Filling

Fill the manometer with water before checking pressure. Use only distilled water. Add some colored water vegetable dye so the scale can be read more easily. With both legs of the manometer open to the atmosphere, fill the tube until the top of the fluid column is near the zero mark on the scale. Shake the tube to eliminate any air bubbles.

Installing, Reading, and Cleaning

1. Support the manometer vertically. Make sure the fluid level is in line with the zero indicator on the graduated scale.
2. Connect one leg of the manometer to the source of the pressure or vacuum. Leave the other leg open to atmospheric pressure.
3. Start the engine and allow it to reach normal operating temperature. Then run the engine to high idle. The manometer can be read after 10 seconds.

4. Record the average position of the fluid level when it is above and below the zero indicator. Add the two figures together. The sum of the two is the total column of fluid (distance A). This represents the crankcase pressure in inches of water (in-H_2O).

   At times, both columns of the manometer will not travel the same distance. This is no concern if the leg is not connected to the pressure or the vacuum source is open to the atmosphere.

5. Compare the manometer reading with engine specifications.
6. When the test is done, clean the tube thoroughly using soap and water. Avoid liquid soaps and solvents.

Fuel Pressure Gauge ZTSE4681

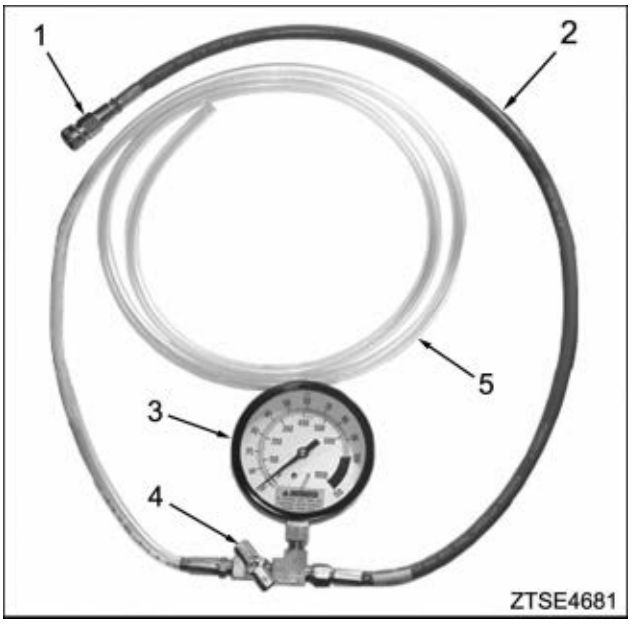


Figure 1151 ZTSE4681

1. Quick disconnect check valve
2. Fuel test line
3. Fuel Pressure Gauge ZTSE4681
4. Inline shut-off valve
5. Clear test line

The Fuel Pressure Gauge ZTSE4681 is used to check for fuel pressure and aerated fuel in the low-fuel pressure system.

Fuel Pressure Test Kit ZTSE4657



Figure 1152 ZTSE4657

1. Compression fitting 1/8 NPT
2. 90-degree elbow
3. Quick disconnect check valve
4. Fuel pressure test adapter

The Fuel Pressure Test Kit ZTSE4657 includes a quick disconnect check valve and fittings that can be used to make a test line to check fuel pressure at the high-pressure fuel rail.

Charge Air Cooler Test Kit ZTSE4341

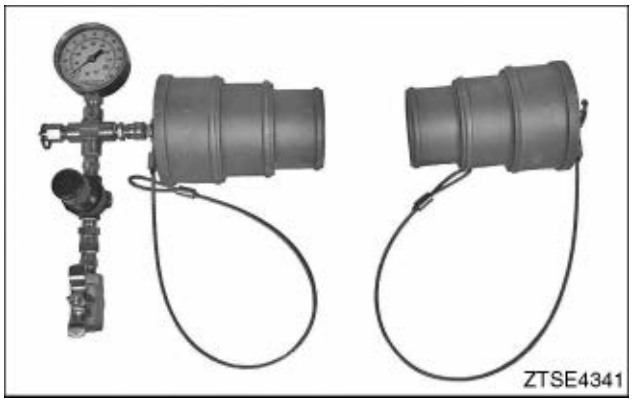


Figure 1153 ZTSE4341

The Charge Air Cooler Test Kit ZTSE4341 is used to pressurize the charge air cooler and piping to check for leaks.

EGR Mixing Bowl Guide Pins ZTSE4945



Figure 1154 ZTSE4945

The EGR Mixing Bowl Guide Pins ZTSE4945 are used while installing the EGR mixing bowl to not damage the gasket.

EGR Valve Puller ZTSE4941

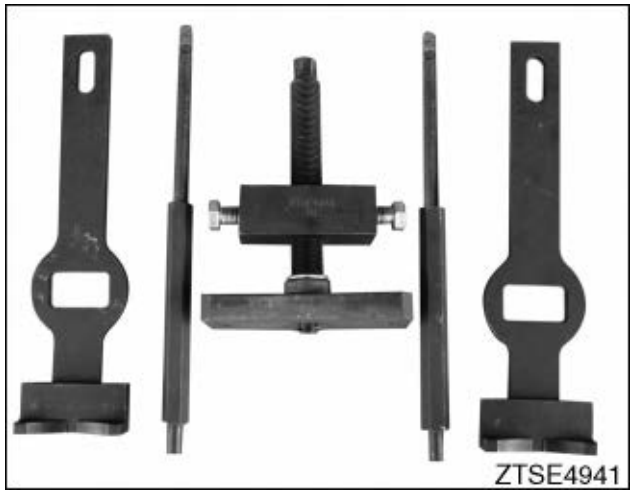


Figure 1155 ZTSE4941

The EGR Valve Puller ZTSE4941 is used to removed the EGR valve without damaging the valve.

Fuel Intake Restriction and Aeration Tool ZTSE6009



Figure 1156 ZTSE6009

The Fuel Intake Restriction and Aeration Tool ZTSE6009 is used to check for pressure and aerated fuel in the low-fuel pressure system.

Fuel/Oil Pressure Test Coupler ZTSE4526



Figure 1157 ZTSE4526

The Fuel / Oil Pressure Test Coupler ZTSE4526 is used with the fuel pressure test fitting for an easy connection to measure fuel pressure.

Fuel Test Fitting ZTSE4692



Figure 1158 ZTSE4692

The Fuel Test Fitting ZTSE4692 is used to measure fuel intake restriction or fuel pressure.

When measuring fuel intake restriction, the fitting is installed at the diagnostic port (intake-side) of the fuel filter housing.

When measuring fuel pressure, the fitting can be installed on the fuel rail instead of the Shrader valve.

The Fuel/Oil Pressure Test Coupler ZTSE4526 can then be connected to the fuel test fitting to measure fuel pressure or fuel intake restriction.

ICP Test Kit ZTSE4655

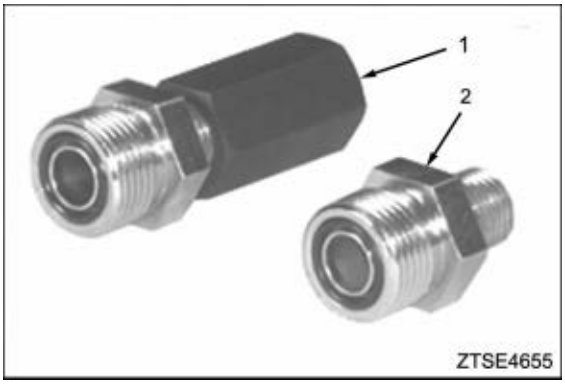


Figure 1159 ZTSE4655

1. Fitting 13/16 - 16 NPT
2. ICP sensor adapter

NOTE: Sensor for test has to be acquired locally.

The ICP Test Kit ZTSE4655 is used to check ICP system diagnostics. The ICP adapter is used with an ICP sensor and the Under Valve Cover (UVC) gasket breakout harness to check the integrity of the high-pressure pump and IPR. The fitting is adapted to an air line to pressurize the UVC components and to check for leaks.

Turbo Lifting Bracket ZTSE4942

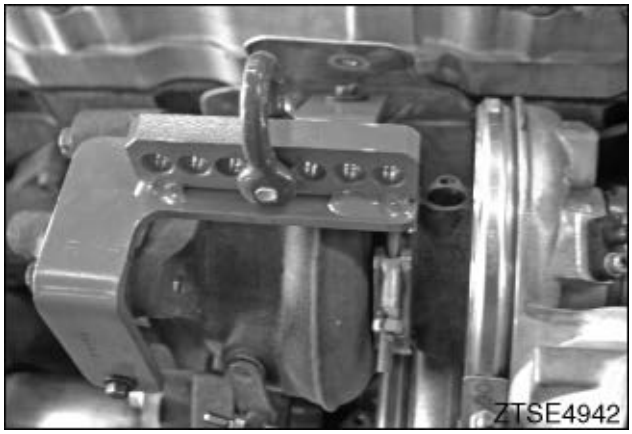


Figure 1160 ZTSE4942

The Turbo Lifting Bracket ZTSE4942 is used to aid in the removal of the turbo assembly.

UV Leak Detection Kit ZTSE4618



Figure 1161 ZTSE4618

The UV Leak Detection Kit ZTSE4618 is used with fuel dye to quickly identify leaks. The fuel dye combines with fuel and migrates out at the leak. The ultraviolet lamp illuminates the leaking fuel dye, which appears fluorescent yellow-green in color.

Clean Fuel Source Tool 15-637-01



Figure 1162 15-637-01

The Clean Fuel Source Tool 15-637-01 is used to provide a clean, alternative fuel source to aid in the diagnosis of the fuel system.

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Aftertreatment Component Locator.....2471

Engine Component Locator

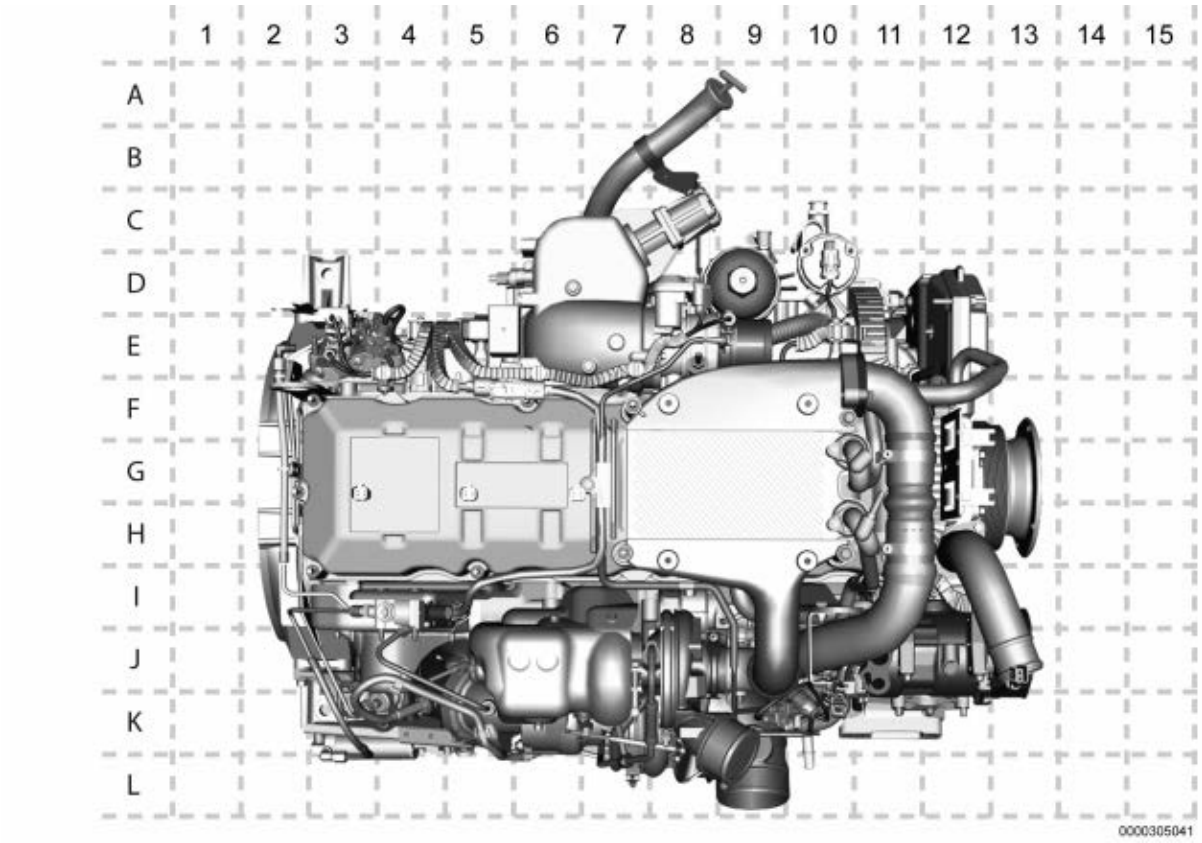


Figure 1163 Component Location – Top

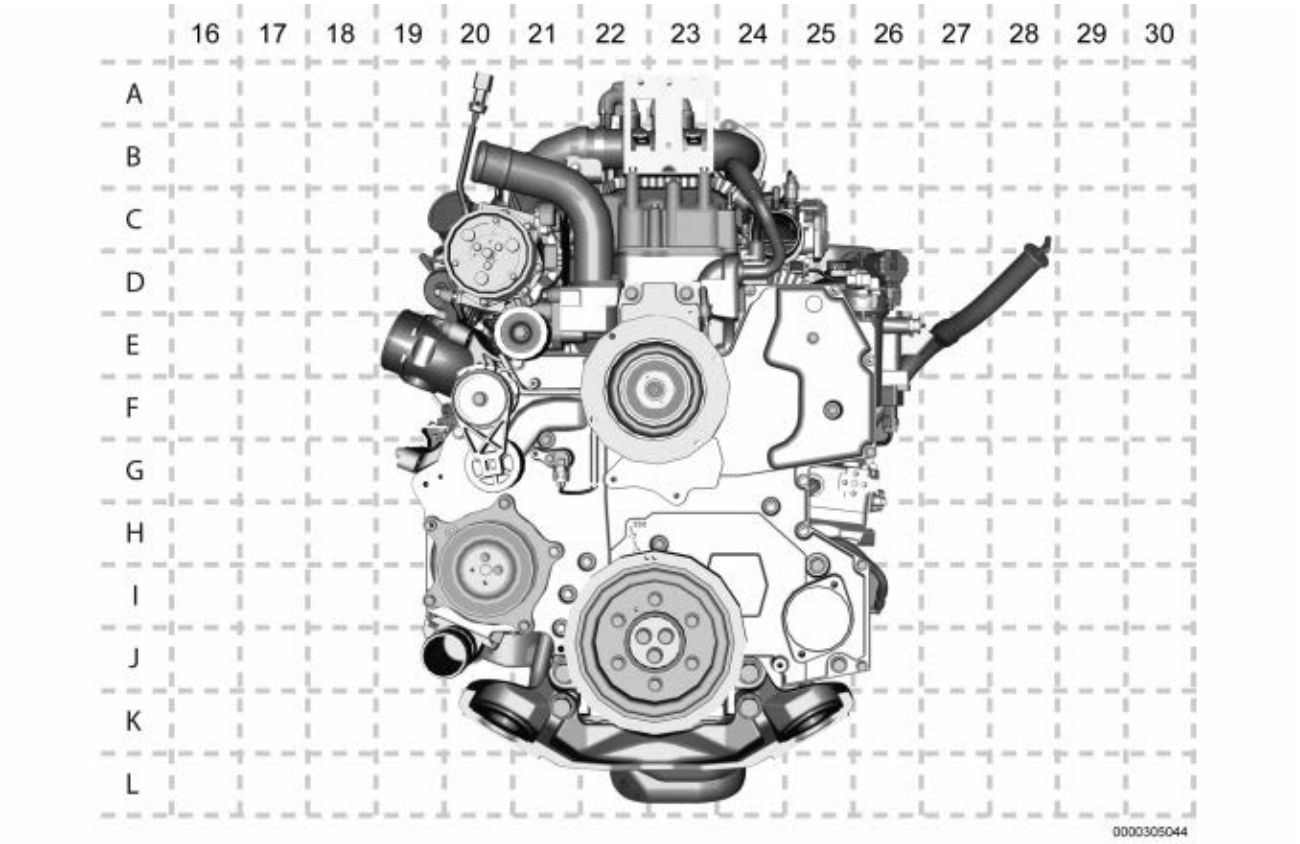


Figure 1164 Component Location – Front

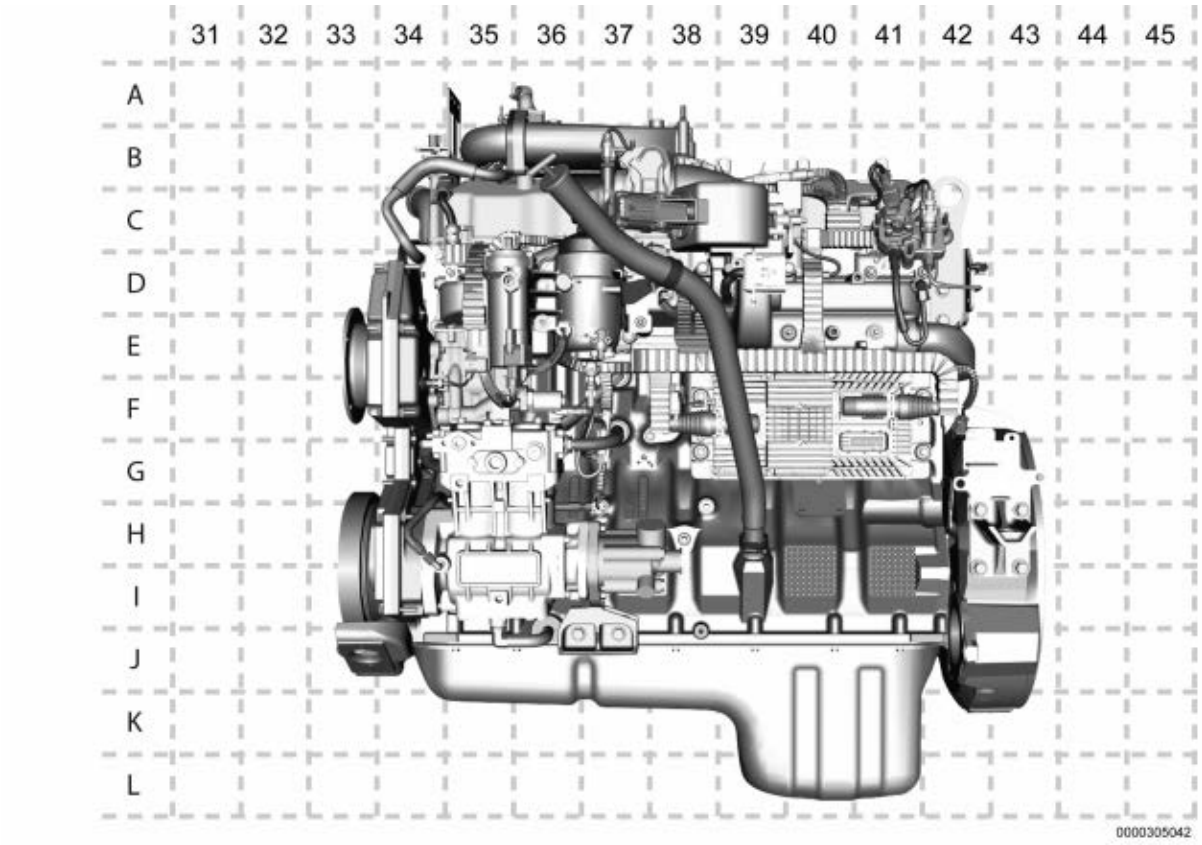


Figure 1165 Component Location – Intake Side

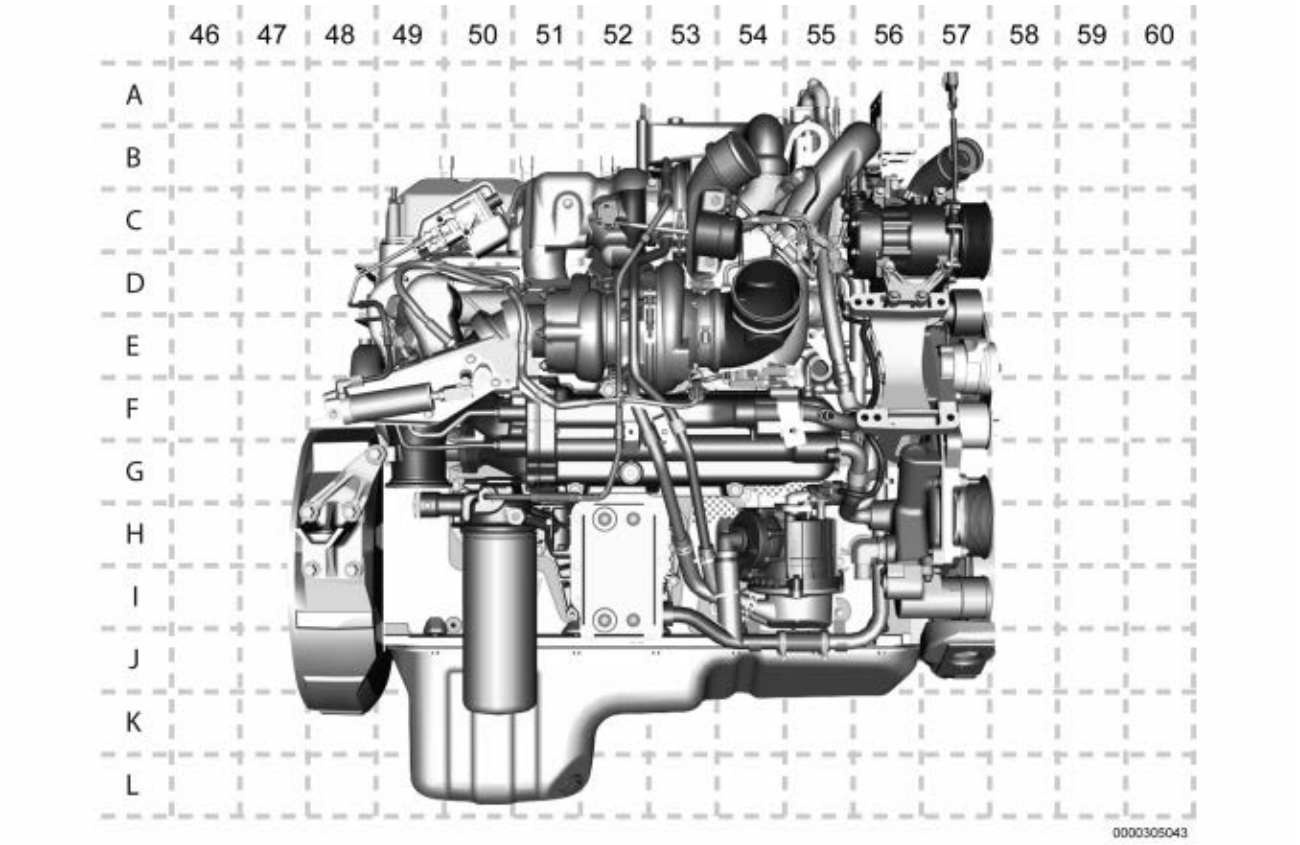


Figure 1166 Component Location – Exhaust Side

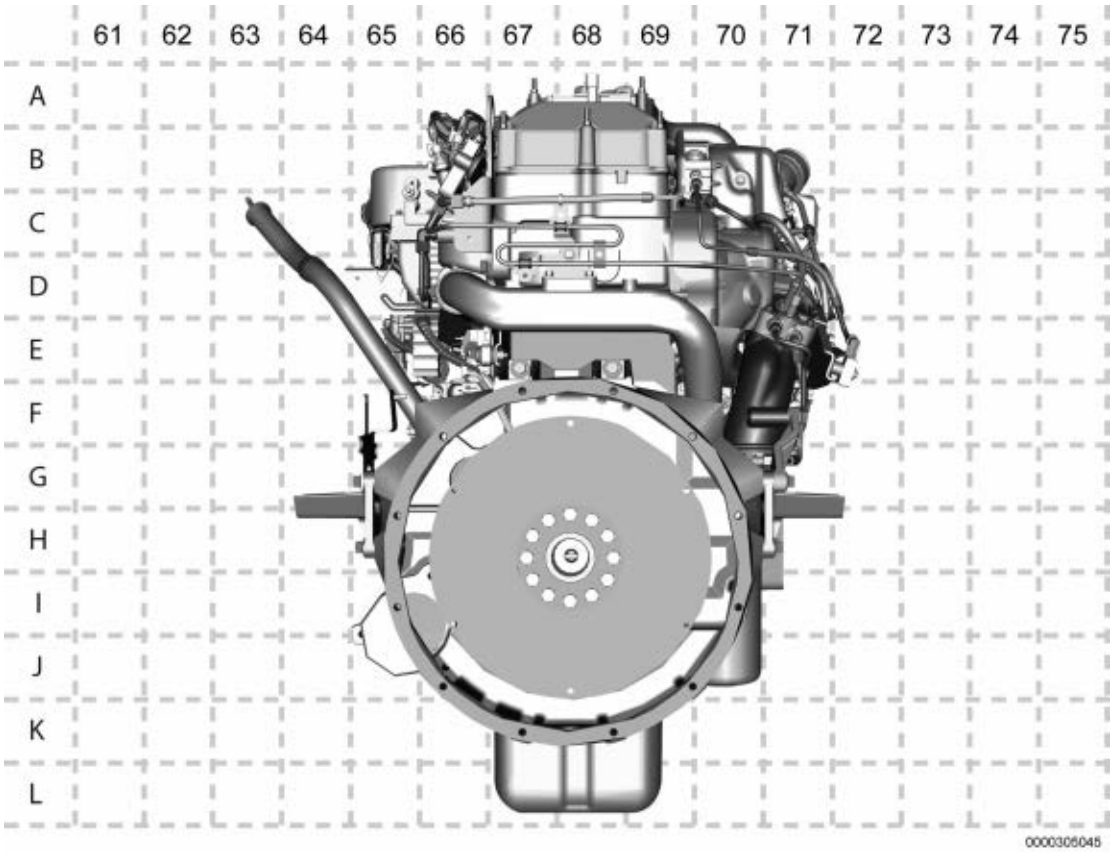


Figure 1167 Component Location – Rear

Engine Component Locations

Component	Location
Air and EGR mixer duct	C-39, D-6
Air Compressor Assembly	I-35, G-25
Alternator Bracket	K-11
Automatic Belt Tensioner	F-20
Cylinder Head Assembly	C-68
Coolant Return Hose (Air Compressor)	G-37
Coolant Supply Hose (Air Compressor)	G-34
Coolant Supply Housing (refrigerant compressor mount)	C-57
Coolant Supply Tube Assembly (EGR cooler)	F-55
Coolant Return Tube Assembly (EGR cooler)	G-56
Coolant Return Tube (Oil Cooler)	J-55
Crankcase Oil Separator Assembly With Turbine	I-55
Crankcase Oil Separator (CCOS) Intake Tube	H-55
Crankcase Oil Separator Outlet Tube	H-54
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Aftertreatment Component Locator



Figure 1168 SCR Switchback Assembly

SCR Switchback Assembly Component Locator Table

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Engine Identification

Engine Serial Number

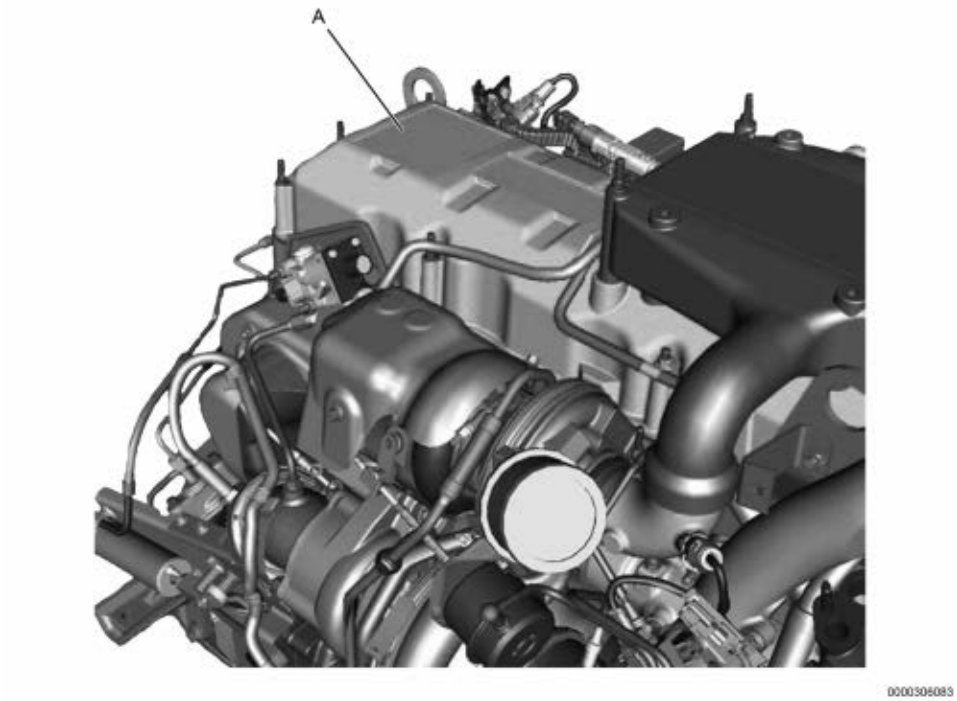


Figure 1169 Engine Serial Number

A. Engine emission label

The engine serial number is located on the engine emission label on the valve cover.

Engine Serial Number Examples:

Navistar® N9 and 10: 570HM2UXXXXXXX

Engine Serial Number Codes:

570 – Engine displacement
H – Diesel, turbocharged, Charge Air Cooler (CAC) and electronically controlled
M2 – Motor truck
U – denotes built plant; U for Melrose Park, Y for Huntsville
7 digit suffix – start with 354XXXX

Engine Emission Label

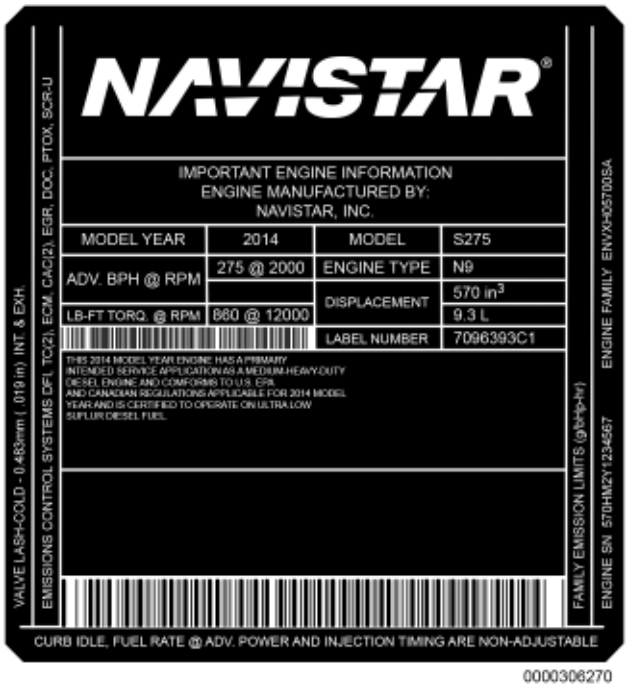


Figure 1170 U.S. Environmental Protection Agency (EPA) Exhaust Emission Label (example)

The U.S. Environmental Protection Agency (EPA) exhaust emission label is attached on top of the valve cover. The EPA label typically includes the following:

- Model year
- Engine family, model, and displacement
- Advertised brake horsepower and torque rating
- Emission family and control systems
- Valve lash specifications
- Engine serial number
- EPA, EURO, and reserved fields for specific applications

Engine Accessory Labels

The following engine accessories may have manufacturer's labels or identification plates:

- Air compressor
- Air conditioning compressor
- Alternator
- Cooling fan clutch
- Power steering pump
- Starter motor

Air Management System

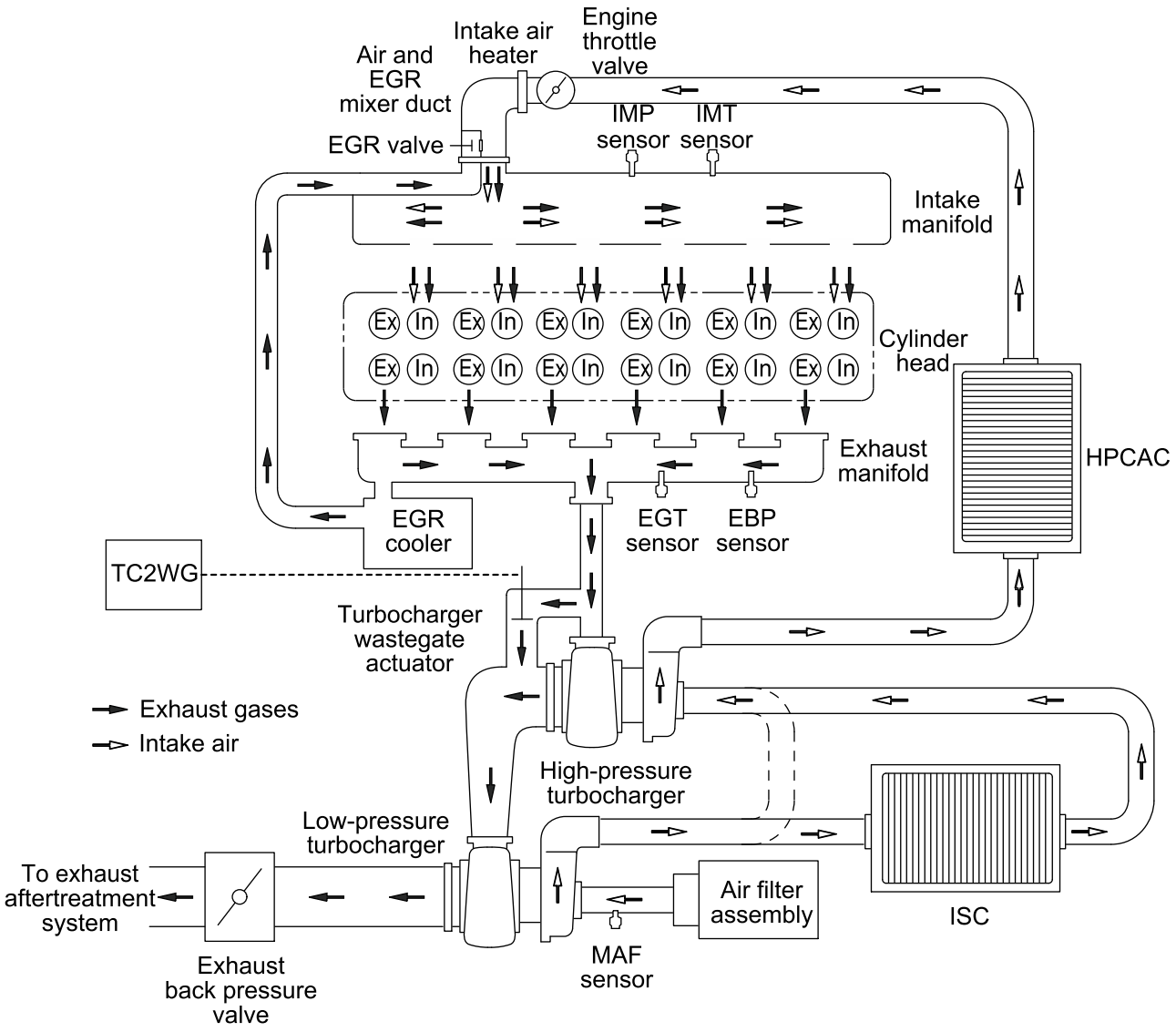


Figure 1171 Air Management System (AMS)

The AMS includes the following:

- Air filter assembly
- Low-pressure turbocharger
- Interstage Cooler (ISC)
- High-pressure turbocharger
- High-Pressure Charge Air Cooler (HPCAC)
- Engine Throttle Valve (ETV)

- Air and Exhaust Gas Recirculation (EGR) mixer duct
- Exhaust and intake valves
- EGR system
- Exhaust system
- Exhaust Back Pressure Valve (EBPV)
- Exhaust – Aftertreatment

Air Flow-Pre Combustion

Fresh air from the air filter enters the low-pressure compressor where it is compressed and directed into the ISC. The high-pressure turbocharger further increases the intake air pressure. The hot compressed air flows into the HPCAC, where it is cooled, then through the ETV located on the Air and EGR mixer duct. If the EGR valve is open, exhaust gas enters the high fin density EGR cooler from the rear of the exhaust manifold, and is transferred to the intake manifold via the EGR crossover duct. The exhaust gas then passes through a port in the intake manifold, and then to the air and EGR mixer duct where it is mixed with filtered intake air. This mixture then flows through the intake manifold and into the cylinder head. If the EGR valve is closed, only filtered intake air flows through the ETV, Air and EGR mixer duct, and into the intake manifold.

Air Flow-Post Combustion

After combustion, gases exit through the cylinder head exhaust valves and ports. Exhaust gas is forced through the exhaust manifold where, depending on the EGR valve position, it is split between the EGR system and the high-pressure turbocharger, low-pressure turbocharger, and the EBPV. The EBPV acts as an aftertreatment device to regulate exhaust temperatures. Exhaust gases flow from the engine through the vehicle aftertreatment system to the exhaust tail pipe.

Air Management Components

Turbochargers

Navistar® N9 and N10 engines are equipped with an electronically-controlled two-stage turbocharging system. This system provides high levels of charge air pressure to improve engine performance and to help reduce emissions. Because of its ability to generate very high charge air pressure levels and avoid Charge Air Cooler (CAC) overloading conditions, the system is fitted with a spring-loaded turbocharger wastegate. The turbocharger wastegate is actuated by charge air pressure. The air pressure to the turbocharger wastegate actuator is controlled by the Turbocharger 2 Wastegate Position (TC2WG) valve. The TC2WG valve is controlled by Pulse Width Modulation (PWM) signals from the Electronic Control Module (ECM). The high- and low-pressure turbochargers are installed as an assembly on the exhaust manifold, located on right side of engine.

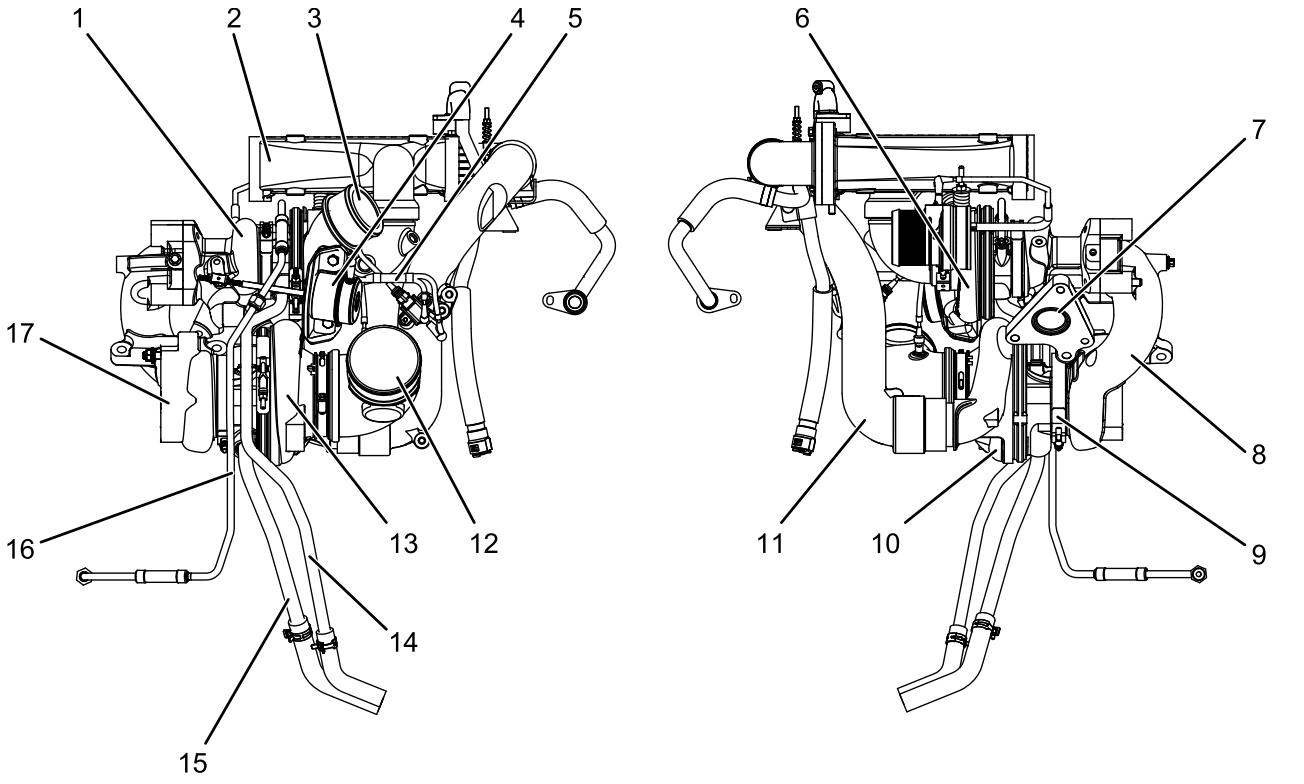


Figure 1172 Low- and High-Pressure Turbocharger Components (below 245 hp shown)

1. High-pressure turbine housing
2. Interstage Cooler (ISC)
3. High-pressure turbocharger outlet
4. Turbo wastegate actuator
5. Turbocharger 2 Wastegate Position (TC2WG) valve
6. High-pressure compressor housing
7. High-pressure turbine intake
8. Low-pressure turbine housing
9. Low-pressure bearing housing
10. Low-pressure compressor housing
11. Air crossover duct
12. Turbo air intake duct
13. Low-pressure compressor housing
14. High-pressure turbo oil drain tube
15. Low-pressure turbo oil drain tube
16. Turbo oil supply tube assembly
17. Low-pressure turbine outlet

The high-pressure turbocharger is connected directly to the exhaust manifold through the high-pressure turbine intake. The high-pressure turbocharger is equipped with a wastegate that regulates the turbocharger boost by controlling the amount of exhaust gases that pass through the high-pressure turbine. When demand for power is low (as during cruising speed), the turbocharger wastegate opens, allowing part of the exhaust gas flow to bypass the high-pressure turbine. The low-pressure turbine is attached directly to the output of the high-pressure turbine. The exhaust gas enters the low-pressure turbocharger through the low-pressure turbine housing and exits through the low-pressure turbine outlet.

Interstage Cooler (ISC)

The ISC is installed between the low-pressure and the high-pressure compressor housings. The ISC air intake is connected to the low-pressure compressor outlet and uses engine coolant to regulate the charge air temperature. The ISC air outlet is connected to the compressor intake on the high-pressure turbocharger.

Exhaust Gas Recirculation (EGR) System

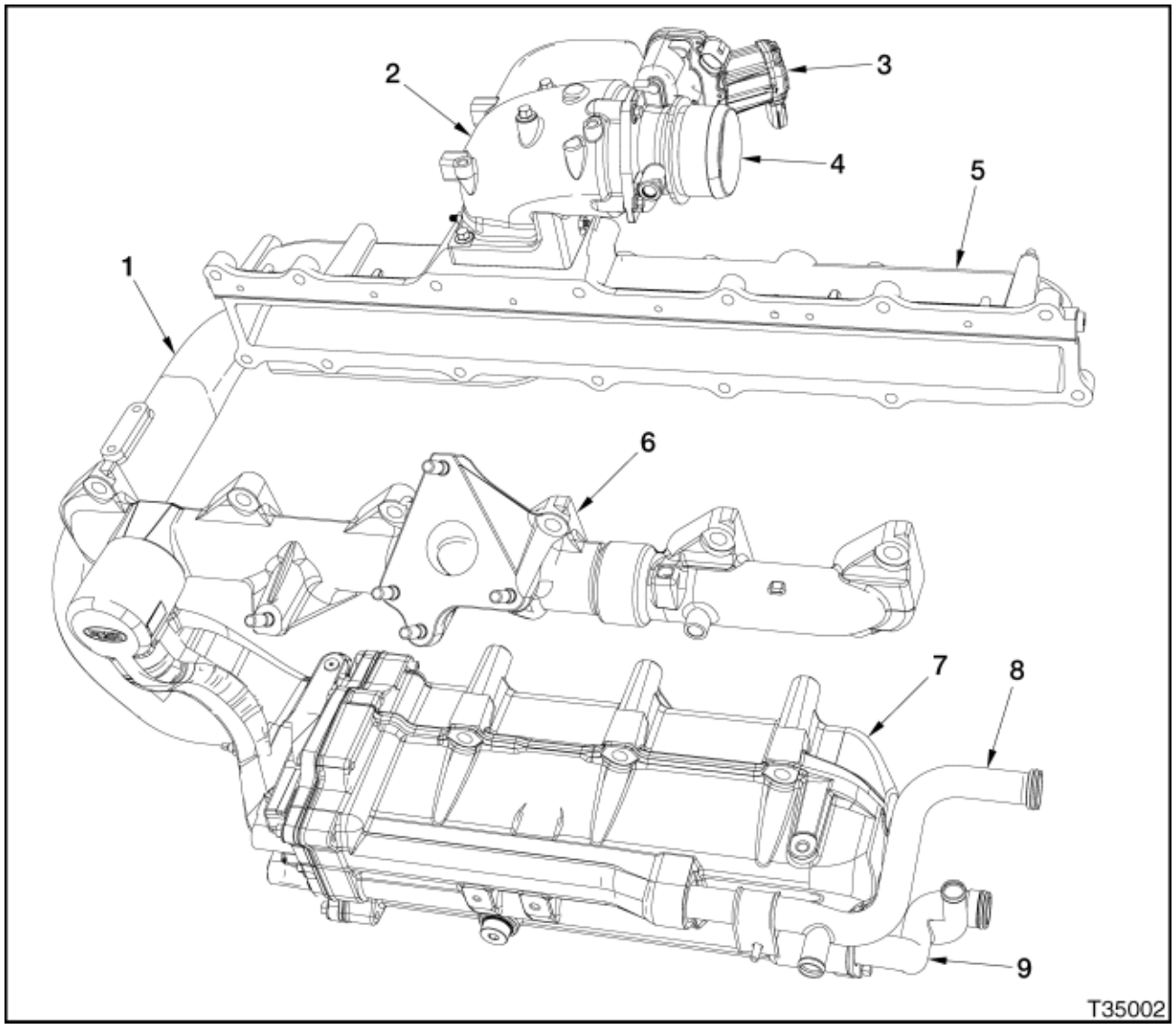


Figure 1173 EGR System

1. EGR crossover duct
2. Air and EGR mixer duct assembly
3. EGR valve assembly
4. Engine throttle valve
5. Intake manifold assembly
6. Exhaust manifold assembly
7. High fin density EGR cooler assembly
8. Coolant supply tube
9. Coolant return tube

The EGR system includes the following:

- Air and EGR mixer duct assembly
- Engine throttle valve
- EGR valve assembly
- Coolant supply tube

- Coolant return tube
- EGR cooler assembly
- EGR crossover duct

The EGR system reduces Nitrogen Oxide (NOx) engine emissions. NOx forms during a reaction between nitrogen and oxygen at high temperatures during combustion. Combustion starts when fuel is injected into the compressed combustion chamber.

When EGR is commanded, the EGR valve opens and allows exhaust gas from the exhaust manifold to flow into the EGR cooler for cooling. This cooled exhaust gas is directed through the EGR crossover duct, into a port in the intake manifold, and directed to the air and EGR mixer duct where it is mixed with filtered intake air.

Exhaust Gas Recirculation (EGR) Valve

The EGR valve consists of three major components, a valve, actuator motor, and Integrated Circuit (IC). The EGR valve is installed in the Air and EGR mixer duct assembly on the intake side of the engine. The EGR valve uses a Direct Current (DC) motor to control position of the valve assembly. The motor pushes directly on the valve stem to open. The valve assembly has two poppets on a common shaft. The IC has three hall-effect position sensors to monitor valve movement.

Exhaust Gas Recirculation (EGR) Closed Loop System

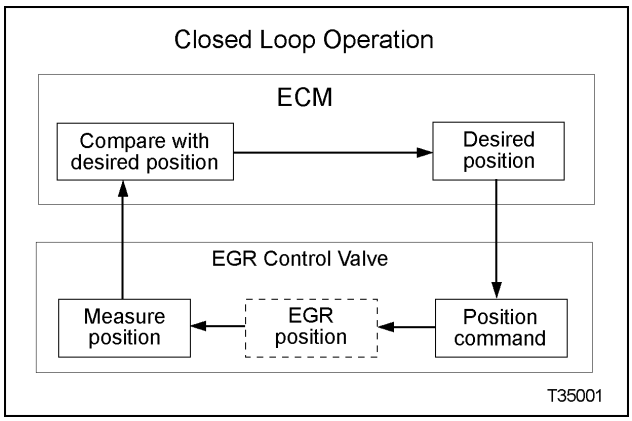


Figure 1174 EGR Closed Loop System

The ECM commands EGR valve position based on engine speed and load conditions. The EGR control valve provides feedback to the ECM on current valve position.

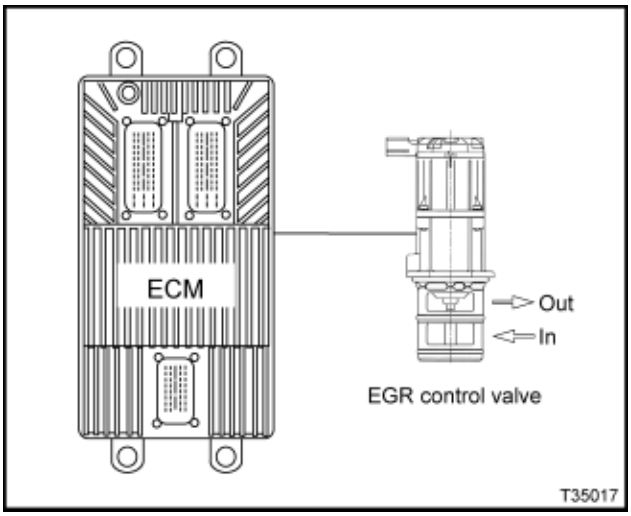


Figure 1175 EGR Control

Crankcase Ventilation System

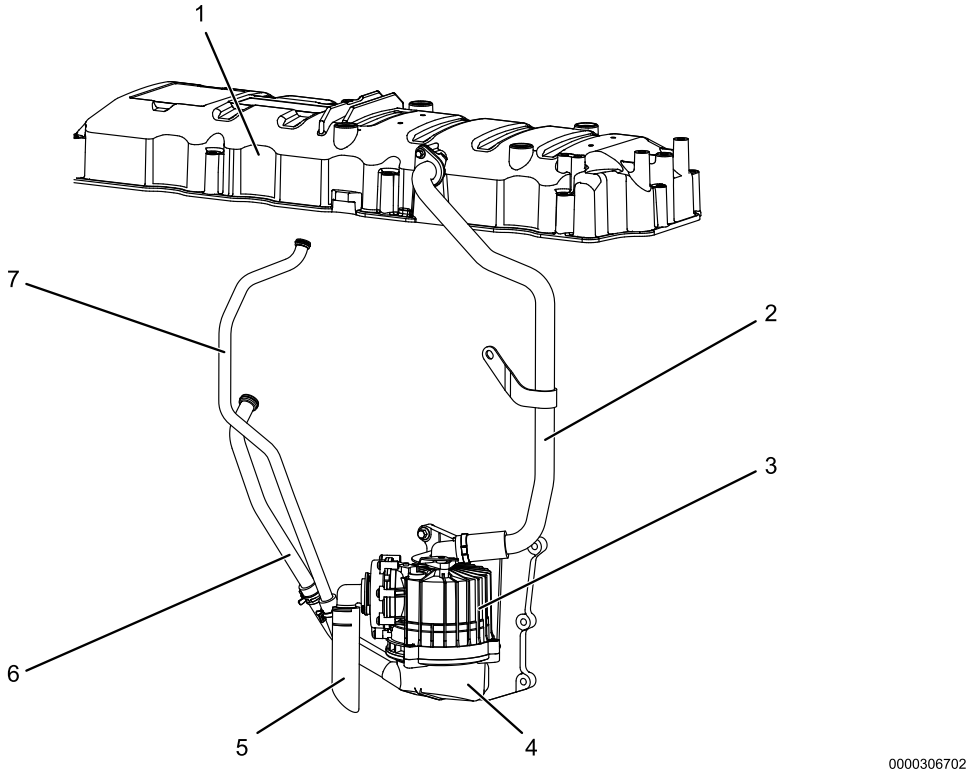


Figure 1176 Crankcase Ventilation

1. Valve cover
2. Crankcase breather intake tube
3. Housing assembly (breather)
4. Housing assembly (turbine)
5. Breather outlet tube
6. Low-pressure turbo drain tube
7. High-pressure turbo drain tube

The crankcase ventilation system uses an engine-mounted oil separator to return oil to the crankcase. The excess crankcase pressure is vented to the atmosphere. Oil-extracted blow-by gases flow from the valve cover, through the crankcase breather intake tube, and into the breather housing assembly. A high-speed centrifugal oil separator driven by engine oil pressure, separates and directs oil to the side of housing assembly. The separated oil drains into the oil separator turbine housing, through the crankcase, and into the oil pan. The oil separator is located inside and toward the top of the housing assembly. The turbine housing also provides oil drainage from the low-pressure and high-pressure turbochargers. The low-pressure and high-pressure turbocharger oil drain tubes direct turbocharger drain oil into the turbine housing. The oil drains out of the turbine housing, through the crankcase, and into the oil pan. Blow-by gases are directed through the breather outlet tube to the atmosphere.

Aftertreatment System

Aftertreatment (AFT) System

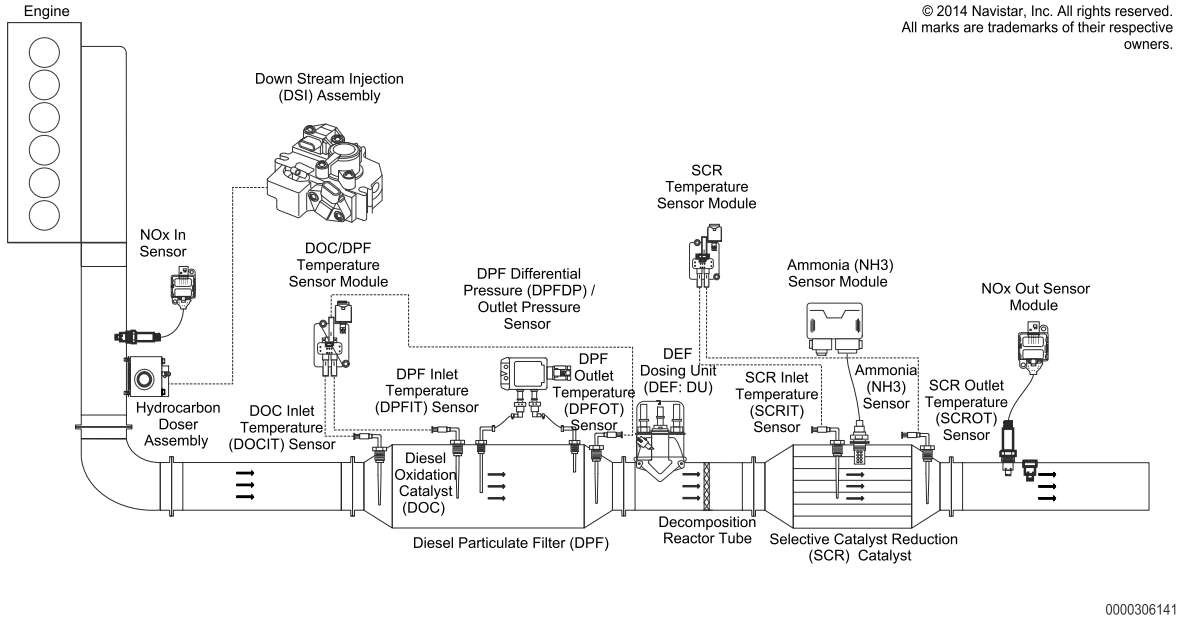


Figure 1177 Aftertreatment (AFT) system

The AFT system, part of the larger exhaust system, processes engine exhaust to meet emission requirements. The AFT system traps particulate matter / soot and prevents it from leaving the tailpipe. The AFT system also reduces Nitrogen Oxides (NOx).

AFT Control System

The control system performs the following functions:

- Monitors exhaust gas temperatures using Diesel Oxidation Catalyst (DOC) In, Diesel Particle Filter (DPF) In, DPF Out, Selective Catalyst Reduction Intake Temperature (SCRIT), Selective Catalyst Reduction Outlet Temperature (SCROT) sensors
- Nitrogen Oxide (NOx) in, NOx out, and Aftertreatment Ammonia (NH_3) sensors
- Controls engine operation for emission control and failure recognition
- May cancel regeneration in the event of catalyst or sensor failure
- Monitors the level of soot accumulation in the DPF using Diesel Particulate Filter Differential Pressure sensor.
- Initiates regeneration automatically when DPF is full with soot and controls engine operation to increase temperature to ensure a successful regeneration
- Monitors NOx levels in the exhaust
- Initiates Diesel Exhaust Fluid (DEF) dosing automatically when NOx levels are above a pre-calibrated threshold
- Monitors and adjusts DEF dosing per Ammonia (NH_3) sensor feedback

DPF

The DPF does the following:

- Captures and temporarily stores particulate matter / soot
- Allows for oxidation (regeneration) of stored particulate matter / soot once loading reaches a particular level (restriction)
- Stores non-combustible ash until ash cleaning maintenance is performed

DOC

The DOC does the following:

- Oxidizes hydrocarbons in exhaust stream
- Provides heat for exhaust system warm-up and DPF regeneration
- Aids in system temperature management for the DPF

Selective Catalyst Reduction (SCR) Catalyst

The SCR catalyst does the following:

- Completes the breakdown of DEF into NH3 and carbon dioxide (CO2)
- Converts NH3 and NOx to Nitrogen gas and water

Decomposition reactor tube

The decomposition reactor tube does the following:

- Uses an internal mixer to ensure even evaporation of DEF into the exhaust stream

Sensors

Sensors output an electronic signal based on temperature or pressure. These signals are used by the control system to regulate the aftertreatment function. The sensors measure the temperature and pressure at the center of the exhaust flow.

Exhaust Back Pressure Valve (EBPV)

The EBPV acts as an aftertreatment device to manage exhaust temperatures. The Engine Control Module (ECM) will signal the EBPV to change the amount of air passing through the valve into the exhaust, through the DOC, and through the DPF. The ECM interprets the increased back pressure as an increased load. In response to the increased pressure / load, the engine increases speed to meet the demand, resulting in increased exhaust temperature.

AFT Conditions and Responses

The operator is alerted audibly or with instrument panel indicators of system status. Automatic (active) or manual (parked) regeneration is required when levels of particulate matter / soot exceed acceptable limits. For additional information, see the applicable *Vehicle Operator Manual* and the vehicle visor label.

Diesel Exhaust Fluid (DEF) Injection

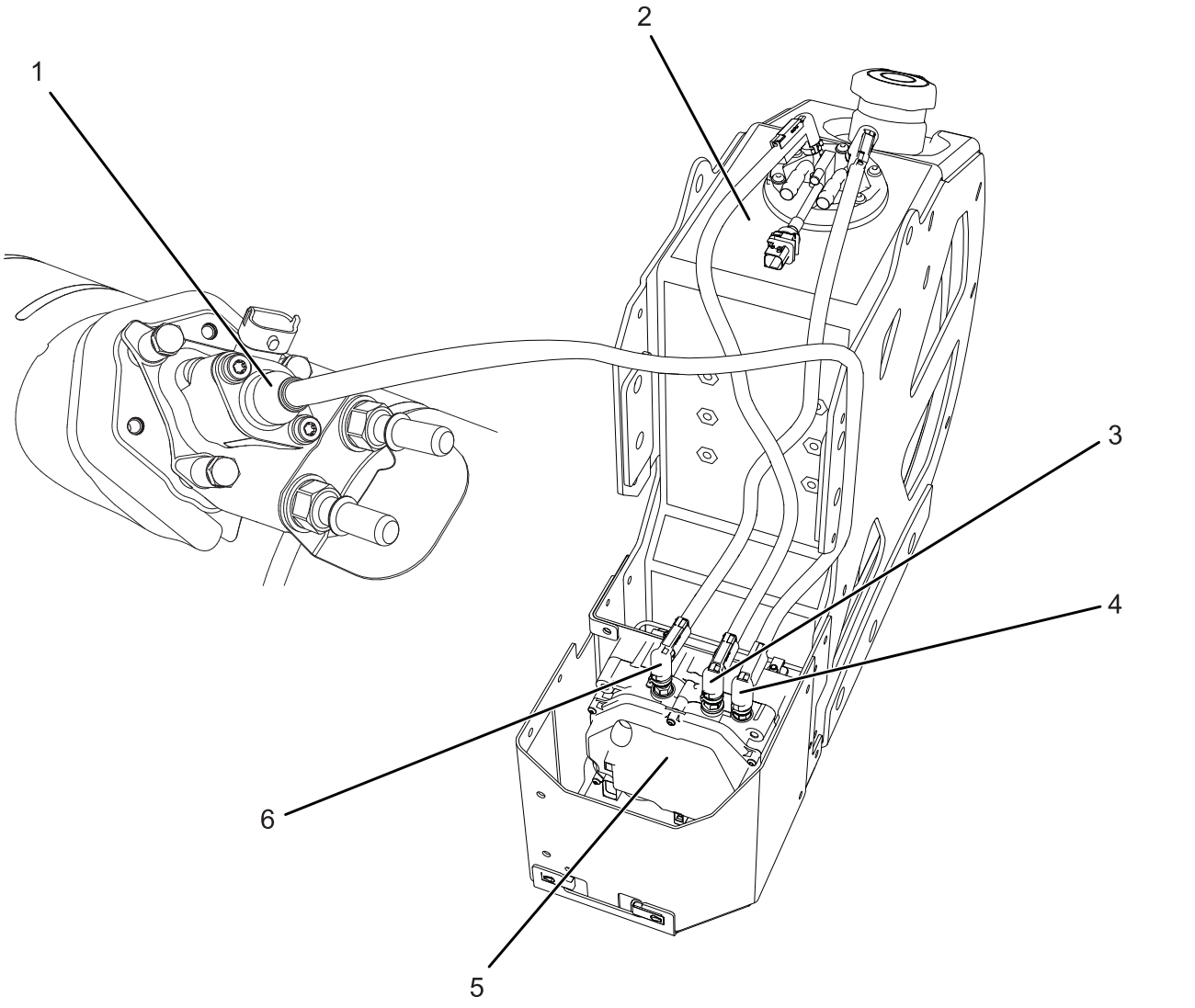


Figure 1178 DEF Injection Components

1. Diesel Exhaust Fluid Dosing Unit (DEFDU)
2. DEF tank
3. DEF supply module return line
4. DEF supply module pressure line
5. DEF supply module
6. DEF Supply Module Supply Line

DEF injection is required when NOx levels exceed acceptable limits. The Aftertreatment Control Module (ACM) determines when DEF injection is required by monitoring signals from the NOx IN sensor module, NOx OUT sensor module, and Ammonia (NH3) sensor. When NOx levels are too high, the ACM commands the DEF Supply Module ON, allowing DEF to be drawn from DEF tank (Figure 1178) (Item 2), through the supply line (Figure 1178) (Item 6), and on to the DEF supply module (Figure 1178) (Item 5). DEF then exits the supply module (Figure 1178) (Item 5) and travels to the DEFDU (Figure 1178) (Item 1) through the pressure line (Figure 1178) (Item 4). The ACM then commands the DEFDU ON allowing DEF to be sprayed into the aftertreatment system.

Downstream Injection System

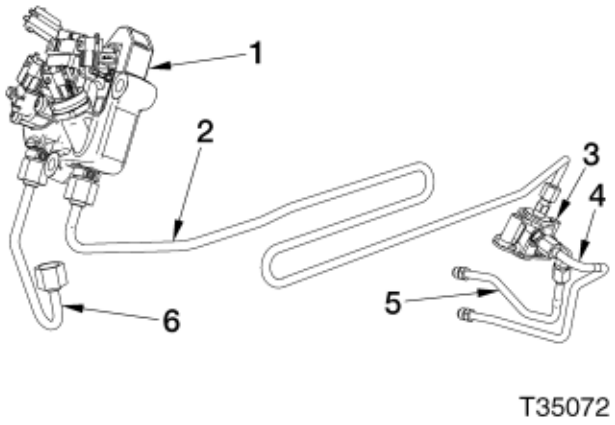


Figure 1179 Aftertreatment (AFT) system

1. Downstream Injection (DSI) assembly
2. Injection unit intake tube assembly
3. Hydrocarbon Injector (HCI) assembly
4. Injector coolant outlet tube
5. Injector coolant intake tube
6. DSI feed tube assembly

The DSI system includes the following:

- Doser Control Unit (DCU)
- HCI assembly
- DSI assembly
- Coolant lines
- Fuel lines

The DCU is mounted on the chassis of the vehicle. The DCU receives signals from the ECM, and then signals the DSI assembly. The DSI assembly is installed on the left rear of the engine above the intake manifold. When the DCU signals the shutoff valve to open, fuel pressure increases in the upstream cavity of the DSI assembly housing. The upstream pressure sensor immediately signals the DCU that pressure is increased by available fuel. The DCU then signals the dosing valve to open, allowing a specific amount of fuel to be injected into the injector unit intake tube assembly to the hydrocarbon injector assembly. Fuel is injected into the exhaust stream from the hydrocarbon injector assembly, which oxidizes in the DOC. This increases temperature inside the DPF to help convert soot to ash more efficiently. The hydrocarbon injector assembly is cooled with engine coolant from the Exhaust Gas Recirculation (EGR) cooler assembly.

Fuel Management System

Fuel Management System

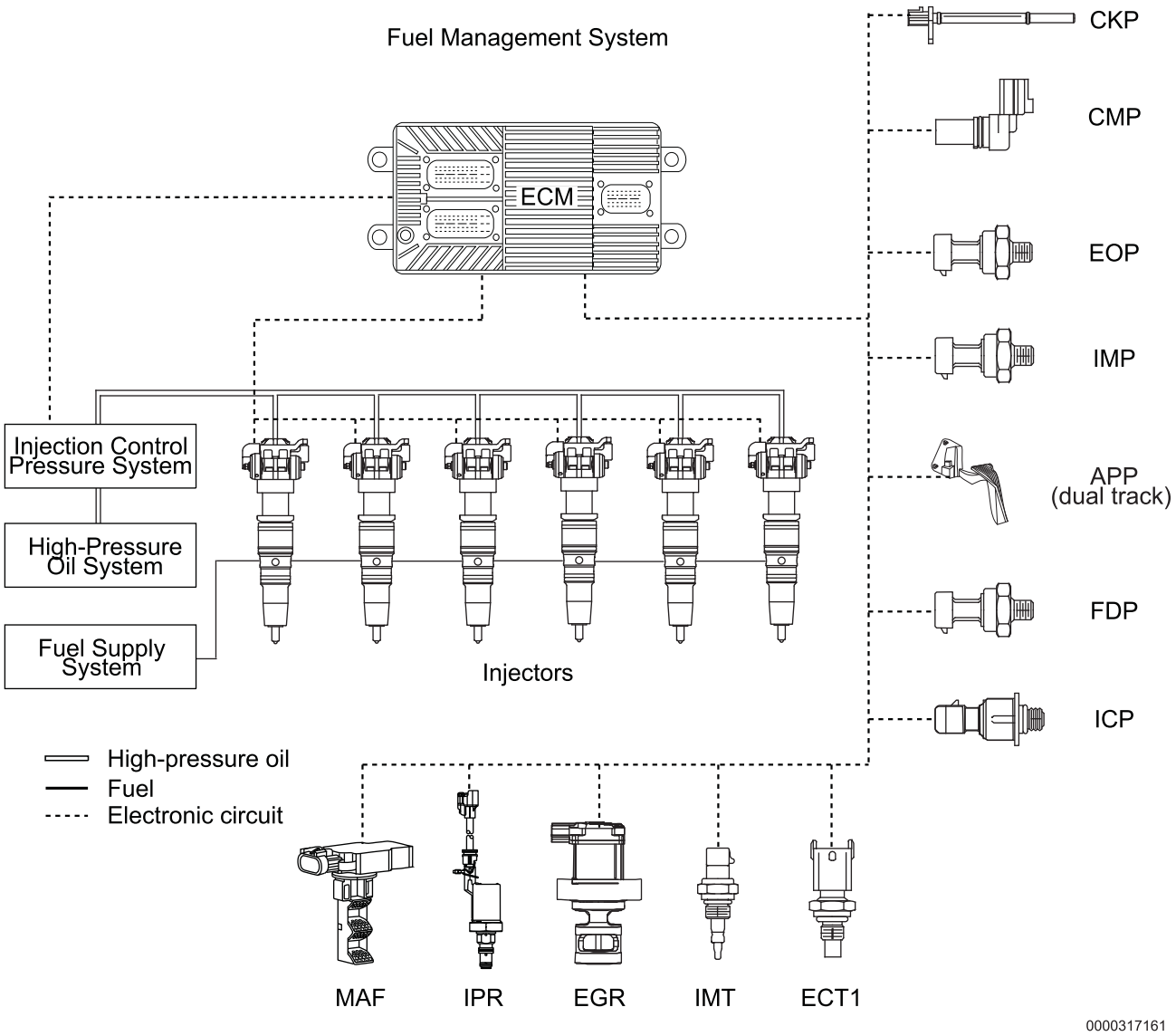


Figure 1180 Fuel Management System

The fuel management system includes the following:

- Injection Control Pressure (ICP) system
- High-pressure oil system
- Fuel injectors
- Fuel supply system
- Electronic control system

Injection Control Pressure (ICP) System

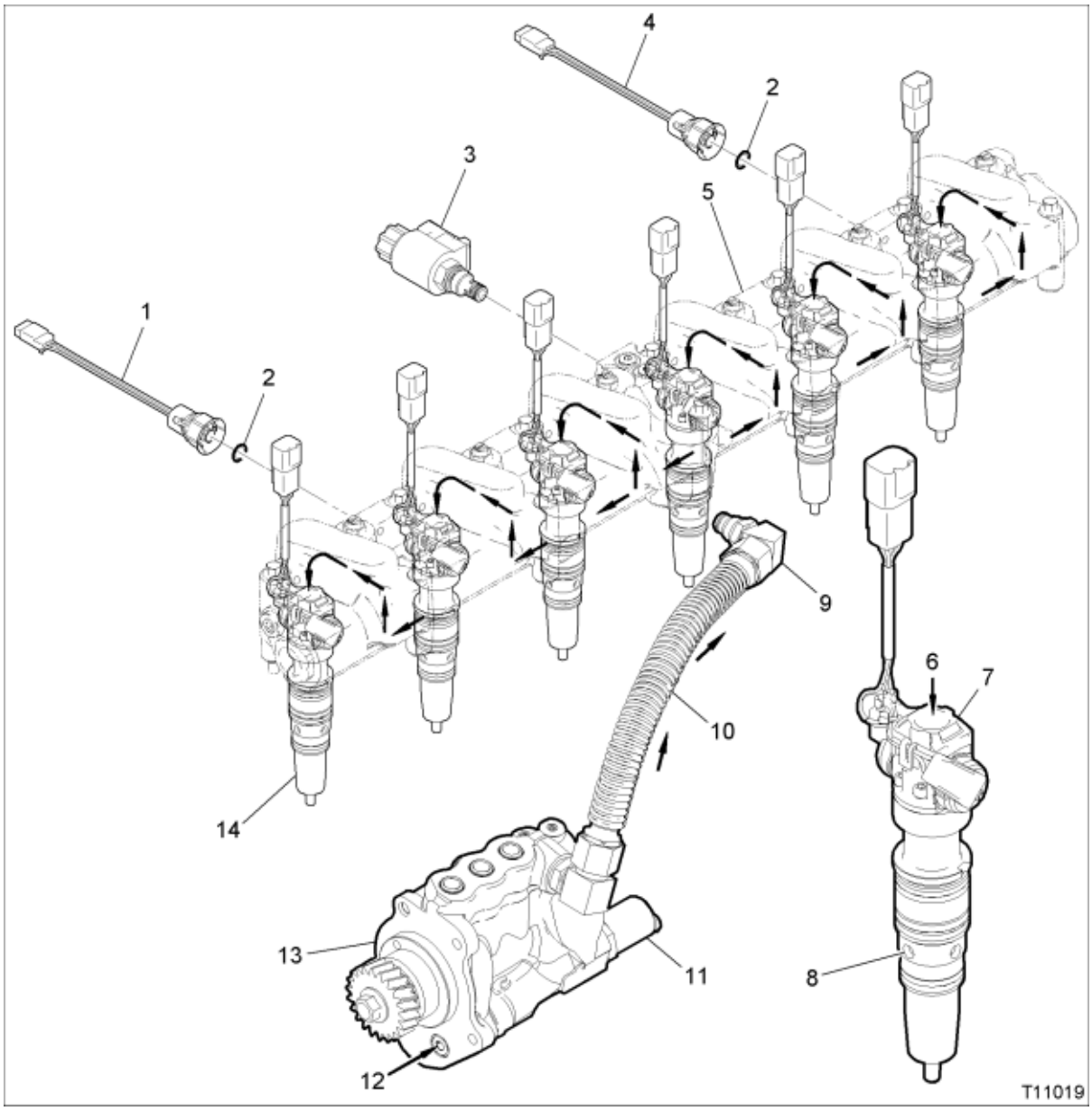


Figure 1181 Injection Control Pressure (ICP) System

1. Engine Compression Brake Pressure (BCP) sensor
2. O-ring (2)
3. Engine Compression Brake (ECB1) valve
4. Injection Control Pressure (ICP) sensor
5. High-pressure oil manifold
6. Injector oil intake from high-pressure oil manifold
7. Oil outlet (2)
8. Fuel intake port (4)
9. 70-degree elbow
10. High-pressure oil hose
11. Injection Pressure Regulator (IPR) valve
12. Oil intake from front cover reservoir
13. High-pressure oil pump assembly
14. Fuel injector assembly (6)

High-Pressure Oil System

The lubrication system supplies the oil reservoir located in the front cover. The reservoir provides oil for the high-pressure oil pump. The pump is mounted on the backside of the front cover and is gear-driven by the upper idler gear. High-pressure oil is directed to the high-pressure oil hose, cylinder head passage, and high-pressure oil manifold. High-pressure oil is used by fuel injectors to pressurize and inject fuel in the cylinders. This occurs when the OPEN coil for each fuel injector is energized. The IPR valve is controlled by the ECM to maintain a desired injection control pressure. The IPR valve controls pressure to a spool valve inside the high-pressure oil pump that throttles oil intake to the pump to regulate injection control pressure. If equipped with optional engine brake, some high-pressure oil is directed internally to the engine brake pistons when the engine compression brake is activated. Since these two systems share a common gallery, a problem with the engine compression brake system can adversely affect injection control pressure and vise versa.

Injection Control Pressure (ICP) Closed Loop System

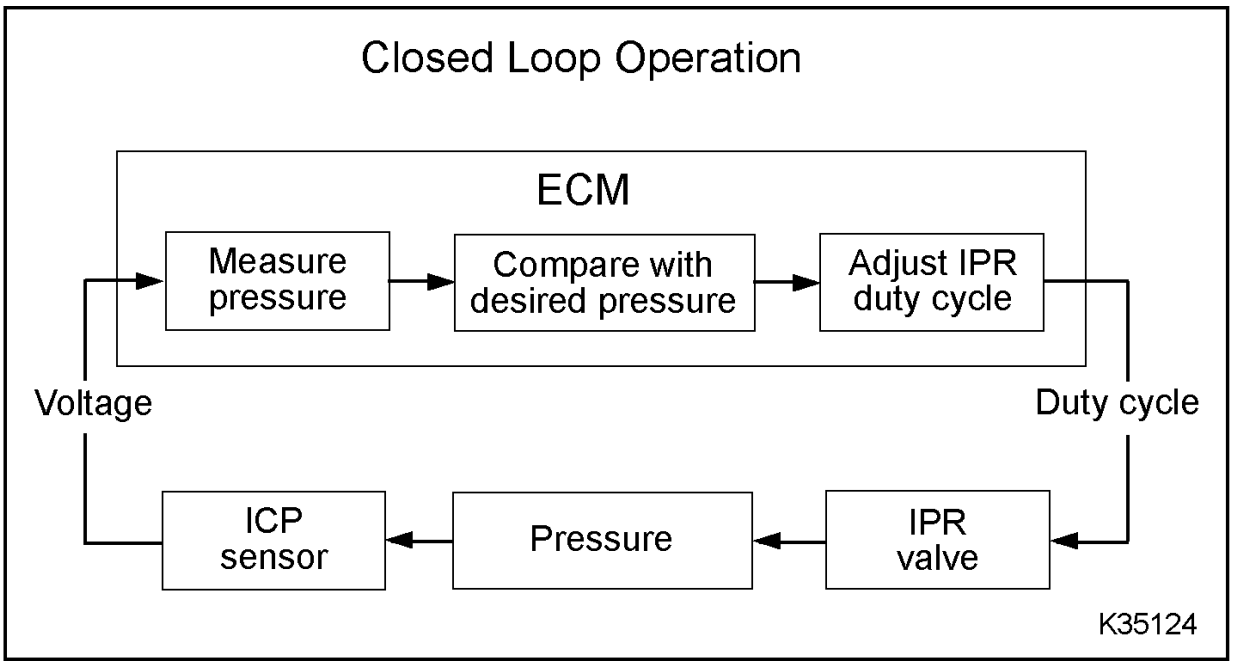


Figure 1182 ICP Closed Loop System

The Injection Control Pressure (ICP) system is a closed loop system that uses the ICP sensor to continuously provide feedback to the Engine Control Module (ECM). The ECM commands the IPR duty cycle to adjust pressure to match engine requirements.

ICP Control System

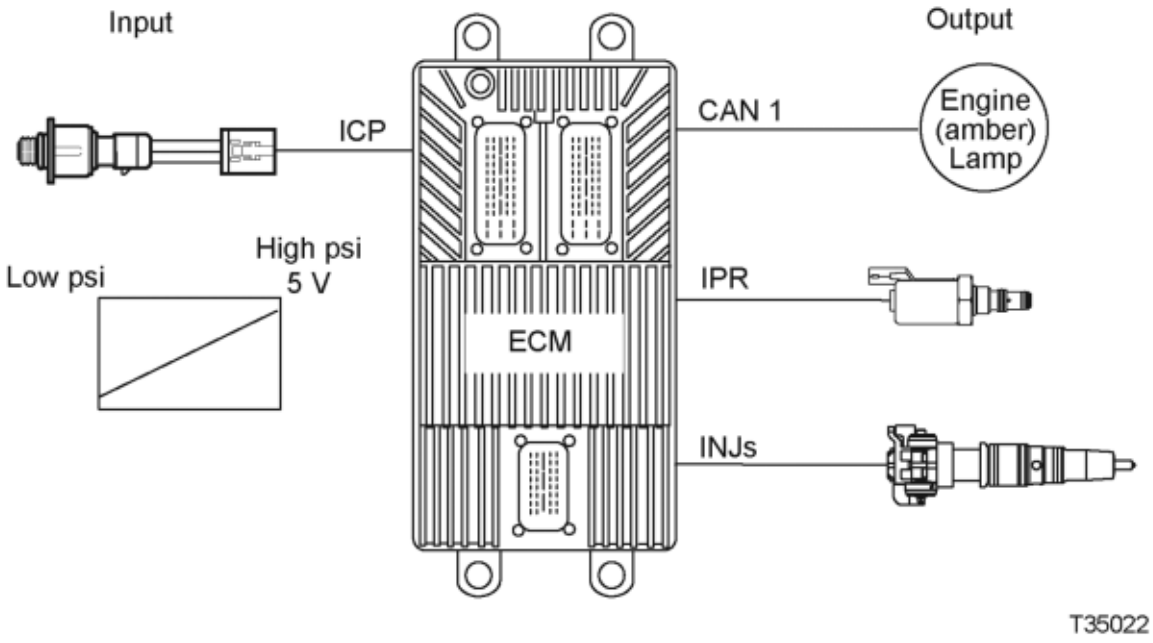


Figure 1183 ICP Control System

The Injection Pressure Regulator (IPR) valve receives a Pulse Width Modulated (PWM) command from the Engine Control Module (ECM). This controls the on / off time IPR valve is energized. The on / off time is controlled by the ECM to meet calibrated desired values. The IPR valve is mounted in body of high-pressure pump. The IPR valve controls pressure to a spool valve inside high-pressure oil pump that throttles oil intake to the pump to regulate Injection Control Pressure (ICP). As demand for ICP increases, the ECM increases current to the IPR valve solenoid. When demand for ICP decreases, duty cycle to the IPR valve decreases which moves spool valve inside high-pressure oil pump to close spool valve that throttles intake to high-pressure oil pump. When ICP electrical signal is out of range, the ECM sets a fault code. When ICP signals are out of range, the ECM goes into open loop operation. IPR valve will operate from programmed default values. ICP sensor is installed in high-pressure oil manifold under valve cover.

Fuel Injector

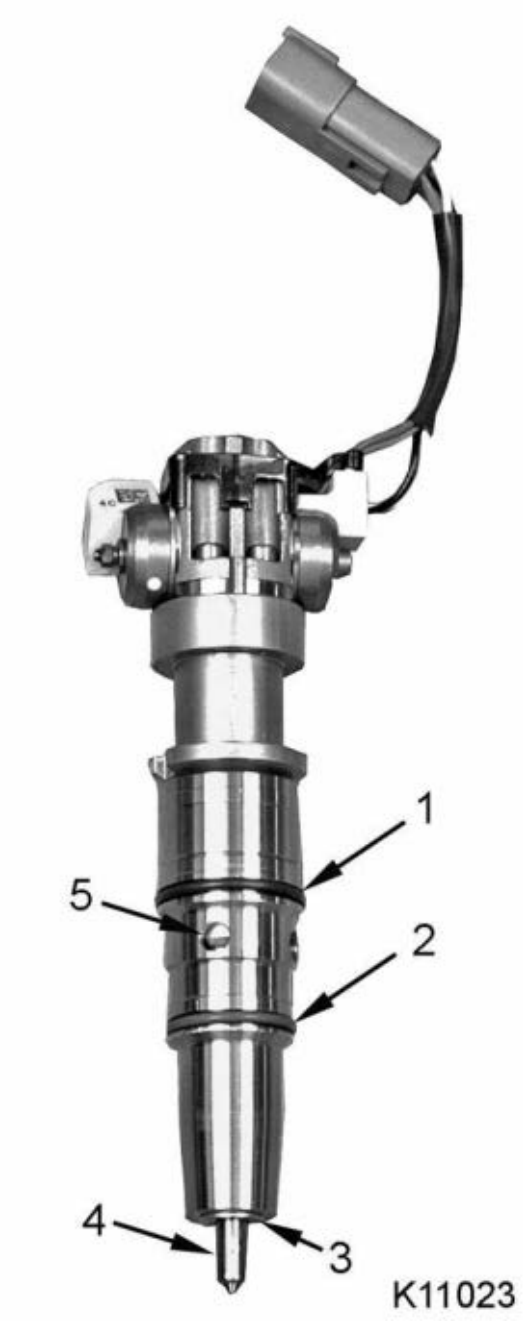


Figure 1184 Fuel Injector

1. Upper O-ring
2. Lower O-ring
3. Nozzle gasket
4. Injector nozzle
5. Fuel intake port

Two 50-volt, 25-amp coils control a spool valve that directs oil flow in and out of the injector. Each injector has a single, four-pin connector that connects to the under valve cover harness. Injectors have an OPEN coil and a CLOSE coil that move the spool valve open and closed using magnetic force. The spool has two positions:

- When the spool valve is open, oil flows into the injector from the high-pressure oil manifold.
- When the spool valve is closed, oil exhausts from the top of the fuel injector and drains back to the crankcase.

Intensifier Piston and Plunger

When the spool valve is open, high-pressure oil enters the injector, pushing down the intensifier piston and plunger. Since the intensifier piston is 10 times greater in surface area than the plunger, the fuel injection pressure is also 10 times greater than injection control pressure on the plunger.

Plunger and Barrel

Fuel pressure builds at the base of the plunger in the barrel. When the intensifier piston pushes the plunger down, the plunger increases fuel pressure in the barrel 10 times greater than injection control pressure. The plunger has a hardened coating to resist scuffing.

Injector Needle

The injector needle opens inward when fuel pressure overcomes the Valve Opening Pressure (VOP). Fuel is atomized at high-pressure through the nozzle tip.

Fuel Injector Operation

The injector operation has three stages:

- Fill stage
- Injection
- End of injection

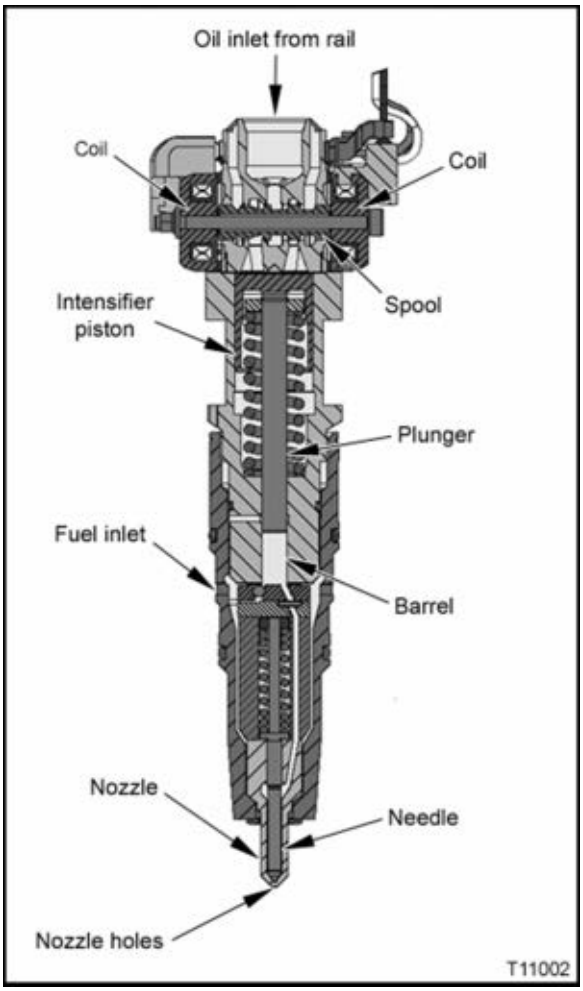


Figure 1185 Fuel Injector Components

Fill Stage

During the fuel fill stage, both coils are de-energized and the spool valve is closed. High-pressure oil from the high-pressure oil manifold is stopped at the spool valve. Low-pressure fuel fills the four ports and enters through the edge filter on its way to the chamber beneath the plunger. The needle control spring holds the needle onto its seat to prevent fuel from entering combustion chamber.

Injection

1. The ECM uses a peak-hold driver to energize the OPEN coil. The Peak current rapidly moves the spool valve open. High-pressure oil flows past the spool valve and onto the top of the intensifier piston. Oil pressure overcomes the force of the intensifier piston spring and the intensifier starts to move down. An increase in fuel pressure under the plunger seats the fuel intake check ball, and fuel pressure starts to build on the needle.
2. The Hold current causes the spool valve to remain open. High-pressure oil from the high-pressure oil manifold continues to flow past the spool valve. The intensifier piston and plunger continue to move and fuel pressure increases in the barrel. When fuel pressure rises above the Valve Opening Pressure (VOP), the needle lifts off its seat and injection begins.

End of Injection

3. When the Engine Control Module (ECM) determines that the correct injector on-time has been reached to deliver the correct amount of fuel, the ECM uses a peak-hold driver to energize the CLOSE coil and may reverse the current through the OPEN coil. The current energizes the CLOSE coil and magnetic force closes the spool valve. The high pressure oil supply to the injector is closed by the spool valve, and oil inside fuel injector is exhausted through the spool valve to the crankcase.
4. The spool valve remains closed when the CLOSE coil is held closed by the Hold current. Oil above the intensifier piston flows past the spool valve through the exhaust ports. The intensifier piston and plunger return to their initial positions. Fuel pressure decreases until the needle control spring forces the needle back on its seat. The close coil is de-energized.

Fuel Supply System

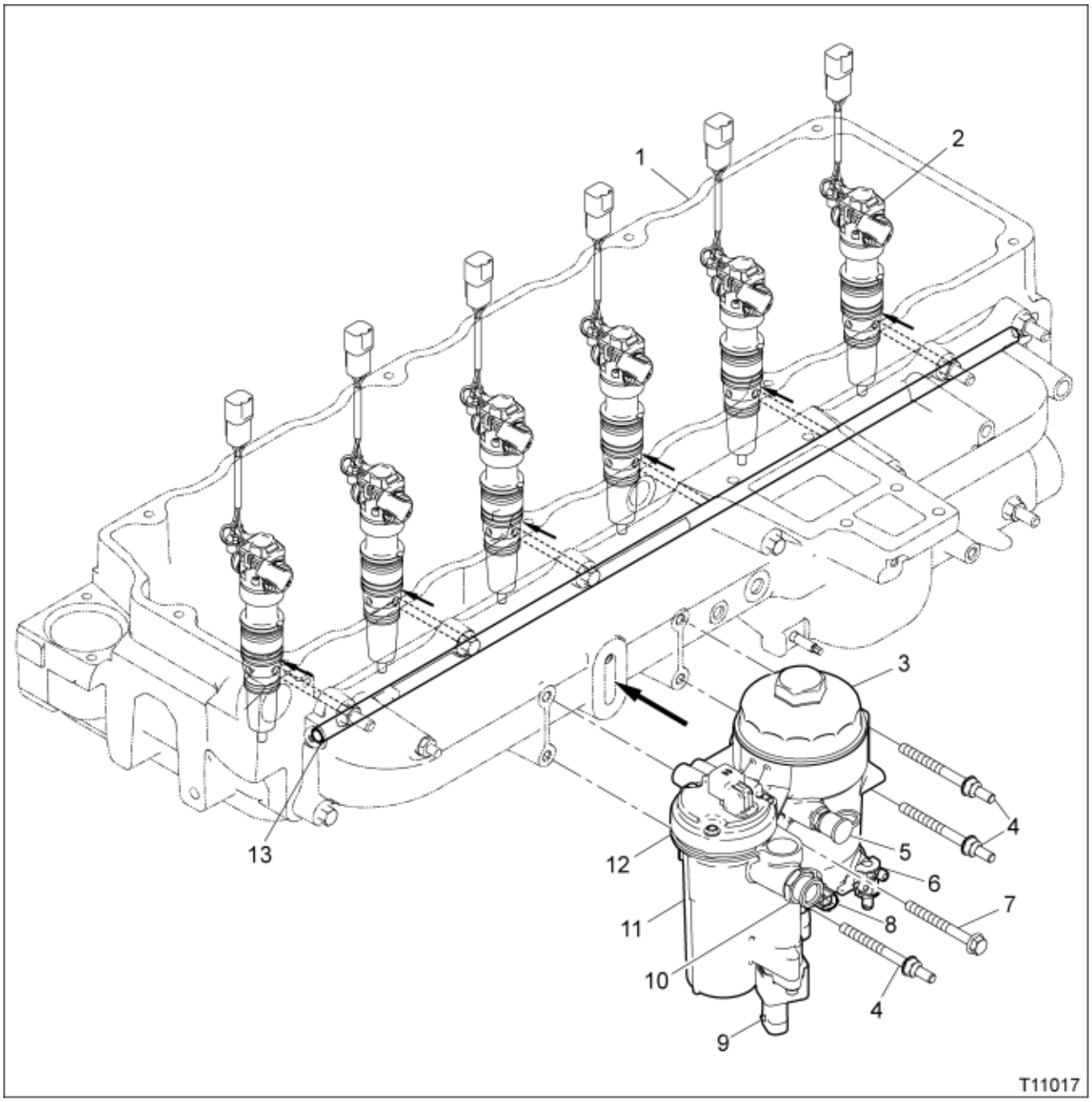


Figure 1186 Low-Pressure Fuel System

1. Cylinder head
2. Fuel injector assembly (6)
3. Fuel filter cap
4. M8 x 75 stud bolt (3)
5. Diagnostic coupling assembly and dust cap
6. Water drain valve assembly
7. M8 x 75 bolt
8. Water In Fuel (WIF) sensor
9. 250 watt heater assembly (optional)
10. Stop Flow adapter assembly (fuel intake)
11. Fuel filter assembly (with optional heater)
12. Electric fuel pump assembly
13. Low pressure fuel rail (cast in intake manifold)

Fuel Supply System Flow

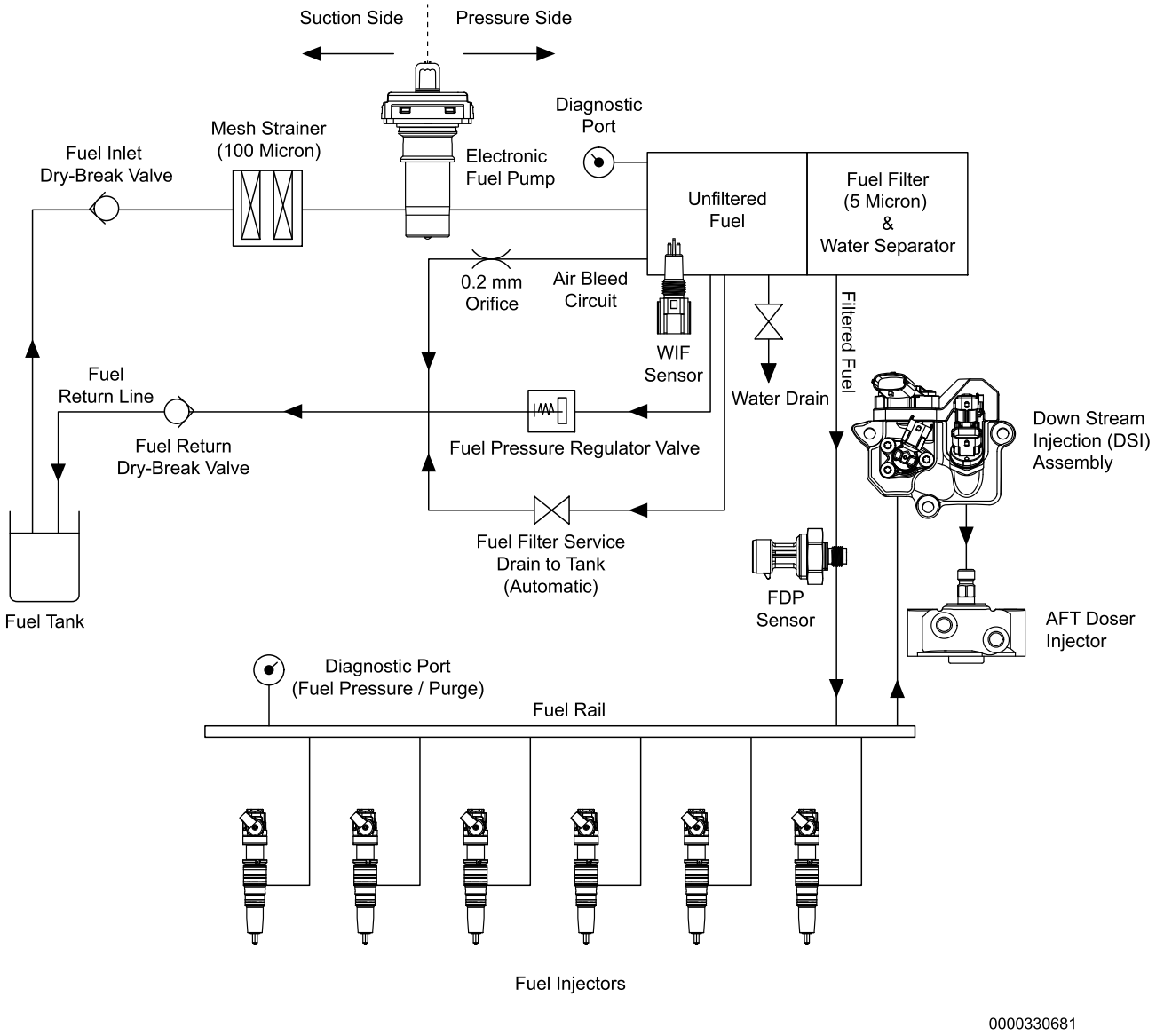


Figure 1187 Fuel Flow

The electric fuel pump draws fuel through fuel lines from fuel tank. Fuel enters the fuel filter assembly and passes through the 100-micron strainer. An optional 250-watt electric heating element is available to warm incoming fuel to prevent waxing and optimize cold weather performance. The heater is installed in fuel filter assembly, below electric fuel pump. Fuel flows from strainer through electric fuel pump to fuel filter for further conditioning. If water is in fuel, the fuel filter element repels the water. The water is collected at the bottom of the main filter element cavity in fuel filter assembly. Fuel flows through the 5-micron filter element and the standpipe. Filter element removes debris from fuel. The standpipe prevents fuel from draining from fuel rail during service. When the fuel filter is removed for servicing, the filter uncovers a drain to allow fuel in the fuel filter housing to drain back to tank during service procedure.

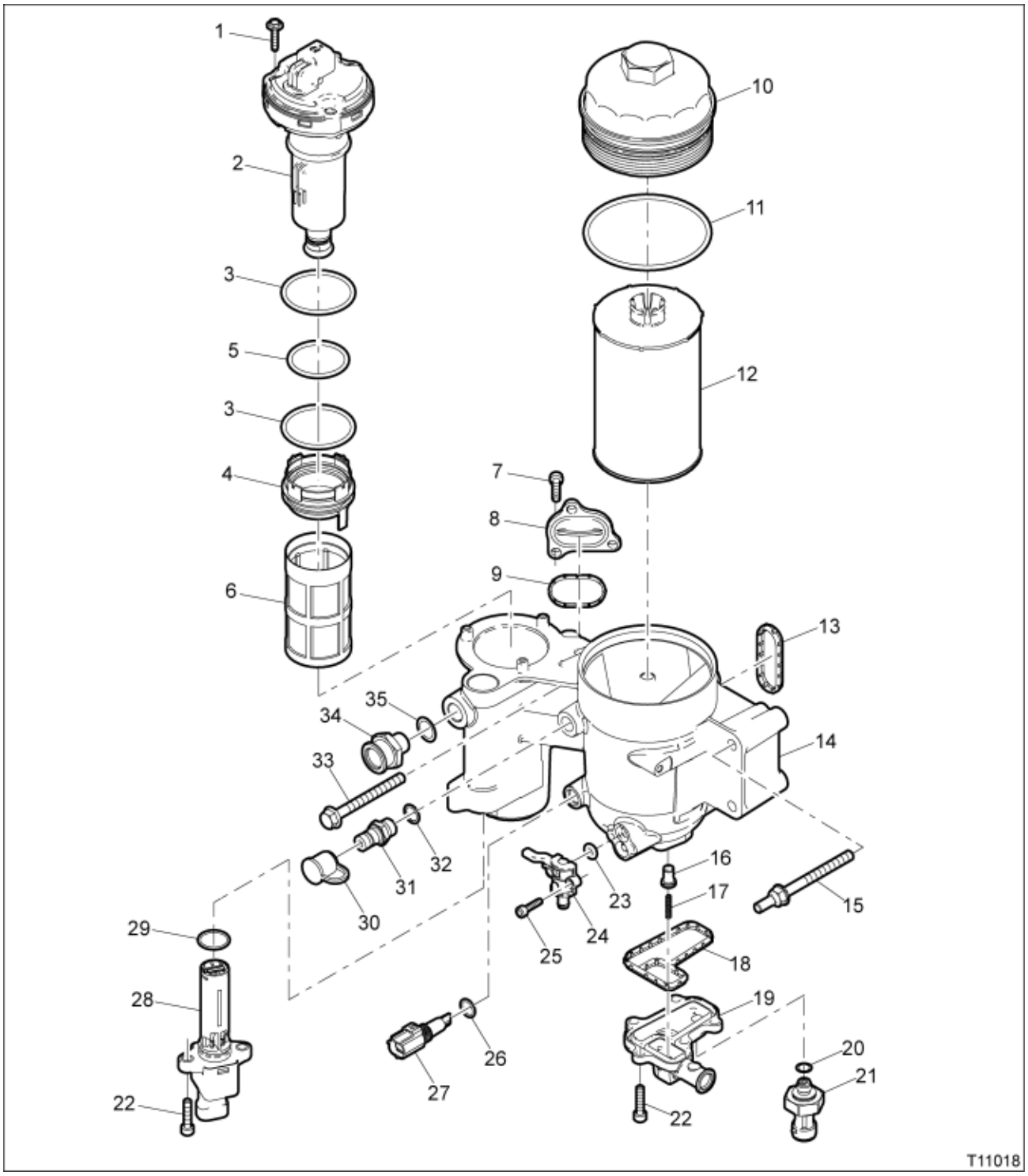


Figure 1188 Fuel Filter Assembly Components

1. M5 x 25 screw (3)
2. Electric fuel pump
3. Pump cover and housing O-ring(2)
4. Pump adapter
5. 3.53 x 40.87 ID O-ring
6. Pump strainer
7. M6 screw (3)
8. Port cover
9. Port cover seal
10. Fuel filter cap
11. O-ring gasket
12. Fuel filter element
13. Irregular molded gasket
14. Fuel filter assembly with heater
15. M8 x 75 stud bolt (3)

16. Fuel pressure regulator valve assembly
17. Fuel pressure regulator spring
18. Cover plate seal
19. Bottom cover plate
20. Sensor O-ring
21. Fuel Delivery Pressure (FDP) sensor
22. M6 screw (7)
23. O-ring
24. Water drain valve assembly
25. M5 x 18 Torx® screw (2)
26. O-ring seal
27. Water In Fuel (WIF) sensor
28. 250 watt heater assembly (optional)
29. Heater plug O-ring gasket
30. Dust cap
31. Diagnostic coupling
32. #906 O-ring
33. M8 x 75 bolt
34. Stop Flow adapter assembly (fuel intake)
35. Gasket

When maximum amount of water is collected in element cavity, the Water In Fuel (WIF) sensor sends a signal to the Electronic Control Module (ECM). The ECM turns on the amber WIF lamp located on the instrument cluster. A water drain valve is located on the fuel filter assembly and can be opened to drain contaminants (usually water) from the assembly. Fuel pump must be commanded ON to drain water from the system. If the drain port is opened without the fuel pump on, the water will NOT drain out. A fuel pressure regulator valve is built into the fuel filter assembly. The regulator valve is calibrated to relieve excessive fuel pressure. Excess fuel is sent through a fuel return line back to the fuel tank. Return fuel is not filtered. Fuel continuously flows from the top of the filter element cavity, through a 0.2 mm air bleed orifice (filter center tube feature), and into the return fuel line. This aids in removing trapped air from the element cavity as a result of servicing. When the fuel filter is removed, a drain-to-tank port is opened. Fuel present in the filter assembly then drains out and back to the tank to provide improved cleanliness during servicing. When fuel lines are removed, a check valve eliminates spillage and ensures fuel line cleanliness. The Fuel Delivery Pressure (FDP) sensor detects low fuel pressure. The FDP sensor sends a signal to the ECM when pressure is below programmed values for various engine conditions. Filtered fuel flows from the fuel filter assembly into the fuel rail. The fuel rail is an integral part of the intake manifold. Fuel flows into six cylinder head passages to each fuel injector. When the fuel injectors are activated, fuel flows from the fuel passages through injector intake ports and into fuel injectors.

Intake Air Heater System

Intake Air Heater System

Intake Air Heater (IAH)

The IAH is primarily used to assist engine start-up in cold weather conditions. In addition, it helps to reduce white smoke emissions by heating the incoming air. The Engine Control Module (ECM) controls a relay through a 12-VDC, digital, high-side driver. When the relay coil is charged with 12 VDC, the high current contacts inside are drawn together. This completes an electric circuit between the IAH and the vehicle's battery. The ECM disables the relay by outputting 0 V. With no voltage across the relay coil, the contacts separate and the connection to the battery is broken, shutting down the IAH. The intake air heater system operates only in temperatures lower than 50°F (10°C).

Engine Lubrication System

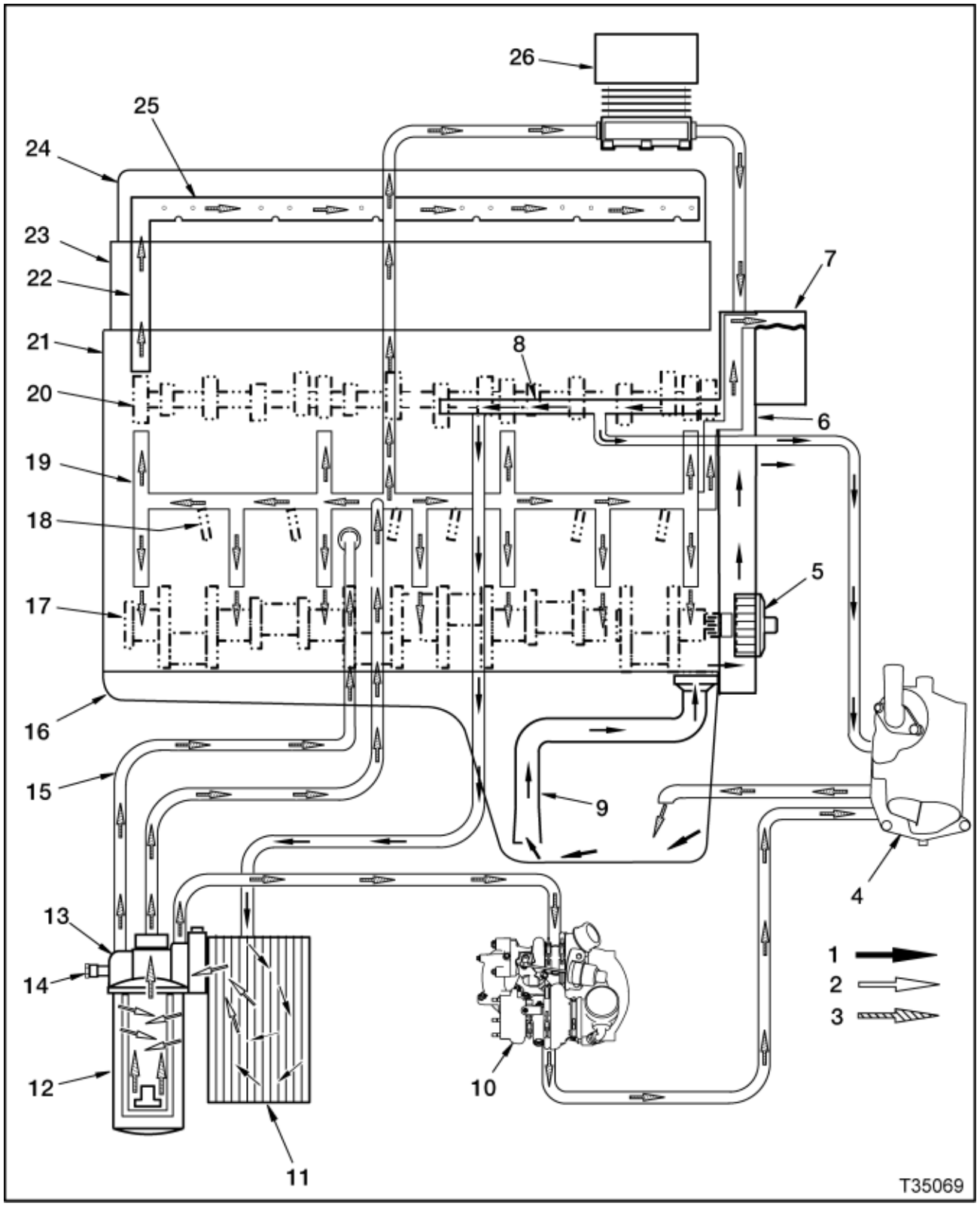


Figure 1189 Lubrication System

1. Unfiltered oil
2. Cooled unfiltered oil
3. Filtered oil
4. Crankcase breather assembly
5. Oil pump
6. Front cover

7. Reservoir for high-pressure oil pump
8. Unfiltered oil gallery
9. Pick-up tube
10. Dual stage turbocharger
11. Oil cooler
12. Oil filter
13. Oil cooler module assembly
14. Oil pressure regulator relief valve
15. Regulator relief valve drain to sump
16. Oil pan assembly
17. Crankshaft
18. Piston cooling jet (6)
19. Main filtered oil gallery
20. Camshaft
21. Crankcase
22. Vertical gallery
23. Cylinder head
24. Valve cover
25. Rocker arm assembly oil gallery
26. Air compressor (optional)

Unfiltered oil is drawn from the oil pan through the pick-up tube and front cover passage by the crankshaft driven oil pump. Pressurized oil is forced through a front cover passage, into the crankcase gallery, and to the oil system module assembly. Oil flow into the oil cooler is controlled by the thermal bypass valve. The thermal bypass valve allows unfiltered oil to bypass the oil cooler when the oil temperature is cold, and flow directly to the oil filter.

As the oil temperature begins to warm, the thermal bypass valve begins to open. This allows unfiltered oil to flow into the oil cooler and oil filter. When the oil temperature is hot, the thermal bypass valve is fully open. This allows all unfiltered oil to flow through the oil cooler before entering the oil filter. Unfiltered oil moves through plates in the oil cooler heat exchanger.

Engine coolant flows around the plates to cool the surrounding oil. Oil that exits or bypasses the oil cooler mixes and enters the spin-on oil filter. Oil flows from outside the filter element toward the inside to remove debris. When the filter is restricted, the oil filter bypass (located in the oil filter can) opens and allows oil to bypass the filter to maintain engine lubrication. The filter bypass valve opens when pressure reaches 60 psi (414 kPa). After passing through the filter, the oil travels past the oil pressure regulator. The regulator directs excess oil back to the oil pan to maintain oil pressure at a maximum of 57 psi (393 kPa).

Clean regulated oil enters the main oil gallery of the engine to lubricate the crankshaft, camshaft, and tappets. The crankshaft has cross-drillings that direct oil to the connecting rods. Oil is also provided to the high-pressure reservoir through a passage in the front cover. Piston cooling jets continuously direct cooled oil to the bottom of the piston crowns.

Oil is provided to the cylinder head from the rear cam bearing through a passage at the rear of the crankcase.

Oil flows through a passage in the cylinder head and rear rocker shaft support, then enters the hollow rocker shaft, which lubricates the rocker arms. The crankcase breather assembly oil separator is driven by unfiltered oil pressure taken from the right side of the crankcase. Oil flows from the crankcase into the breather assembly oil separator. Passages direct the oil through a pressed brass nozzle that controls oil flow into the drive oil separator wheel. Oil drains into the base and mixes with oil from the breather system. The collected oil drains into the crankcase and then into the oil pan.

The turbocharger is lubricated with filtered oil from a supply tube assembly that connects the oil cooler module assembly to the center housing of each turbocharger. Oil drains back to the crankcase through drain tubes connected to the base of the breather housing assembly. The optional air compressor is lubricated with filtered engine oil through a flexible hose. The hose is connected to a tee on the left side of the crankcase near the Engine Oil Pressure (EOP) sensor. Oil drains into the front cover and to the oil pan. Oil can also drain from the bottom of the air compressor through a tube into the crankcase. The front gear train is splash-lubricated with oil that drains from the high-pressure reservoir and the optional air compressor.

Engine Cooling System

Cooling System Description

The engine cooling system includes the following:

- Chassis-mounted radiator
- Interstage cooler (if equipped)
- Coolant fan
- Water intake elbow
- Front engine cover
- Water pump
- Crankcase
- Cylinder sleeves
- Cylinder head
- Oil cooler module assembly
- Air compressor
- Thermostat
- Coolant supply housing / coolant port
- Exhaust Gas Recirculation (EGR) cooler
- Coolant surge tank
- Coolant heater (if equipped)

The water pump pushes coolant into crankcase, low temperature radiator, and EGR cooler.

Coolant flows to crankcase and through water jackets from front to rear. Coolant flows around cylinder liners to absorb heat from combustion. Coolant may also pass by optional engine coolant heater.

Swirling coolant flow in cylinder liner jackets directs coolant through passages in cylinder head gasket and upwards into the cylinder head.

Coolant flows through cylinder head water jackets towards thermostat cavity at the front of the cylinder head. When thermostat is closed, coolant is directed through bypass port, crankcase, front cover, and into water pump. When thermostat is open, bypass port is blocked, and coolant is directed through the radiator.

Coolant passes through radiator and is cooled by moving air from coolant fan. Coolant returns to engine through intake elbow and front cover.

The air compressor is cooled with engine coolant supplied by a hose from the left side of crankcase. Coolant passes through air compressor and returns to cylinder head through a passage in crankcase.

The oil cooler module assembly receives coolant from a passage in crankcase. Coolant passes between oil cooler plates and returns through a tube connected to coolant supply housing.

The EGR cooler receives coolant from water pump through a supply tube at the rear of the front cover. Coolant passing through EGR cooler, flows through cooler plates, cools exhaust gas, and exits through a tube to the rear of the front cover that returns coolant to pump intake. The hydrocarbon injector assembly receives and returns coolant to EGR cooler.

The EGR coolant supply tube also branches off to interstage cooler (above 245 hp), if equipped. The interstage cooler uses coolant to lower charged air temperature that exits from turbocharger low-pressure compressor and enters turbocharger high-pressure compressor.

The surge tank provides expansion space for coolant and deaerates cooling system. The following four vents provide coolant to the tank:

- Engine vent (top of coolant supply housing)
- EGR vent (top of EGR cooler)
- Main radiator vent (top of radiator)
- Interstage cooler vent (top of interstage cooler)

The surge tank returns coolant through surge line, back to water pump intake.

Cab heat is provided by heater core, which receives warmed coolant from coolant supply housing.

Cooling System Components

Coolant Heater (optional)

An optional coolant heater is available to warm engine coolant in cold weather. The coolant heater warms coolant surrounding cylinders. Warmed engine coolant aids in cold engine start-up and performance. The coolant heater is installed on the left side of the crankcase, in front of Electronic Control Module (ECM).

Thermostat Operation

Coolant travels through two ports after it passes through the thermostat. One port directs coolant to the radiator when engine is at operating temperature. The other port directs coolant to the water pump until engine reaches operating temperature. The thermostat begins to open at 190°F (88°C) and is fully open at 205°F (96°C).

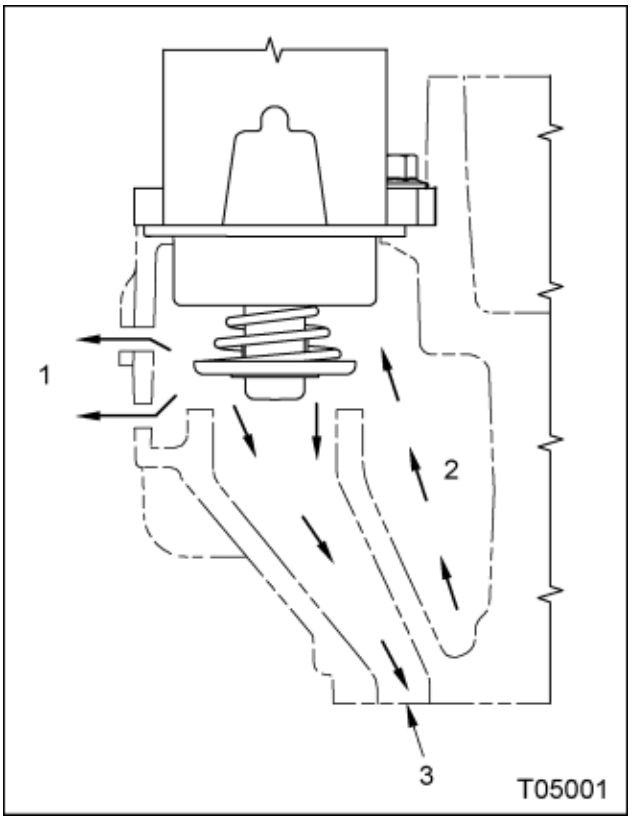


Figure 1190 Thermostat Closed

1. Coolant flow to heater port
2. Coolant in from engine
3. Bypass to water pump

When engine coolant is below 190°F (88°C), the thermostat is closed, blocking flow to radiator. Coolant is forced to flow through a bypass port back to the water pump.

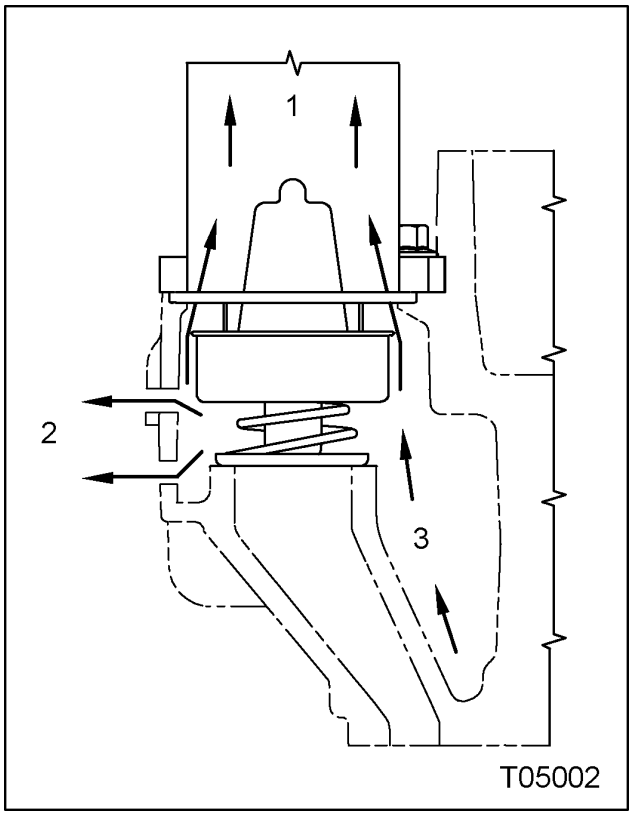


Figure 1191 Thermostat Open

1. Coolant out to radiator
2. Coolant flow to heater port
3. Coolant in from engine

When coolant temperature reaches nominal opening temperature of 190°F (88°C), thermostat opens allowing some coolant to flow to radiator. When coolant temperature exceeds 205°F (96°C), lower seat blocks bypass port, directing full coolant flow to radiator.

Electronic Control System

Electronic Control System Components

Navistar® N9 and N10 engines are equipped with three control modules, the Engine Control Module (ECM), the Aftertreatment Control Module (ACM), Doser Control Unit (DCU).

Operation and Function

The Electronic Control Module (ECM) monitors and controls engine performance to ensure maximum performance and adherence to emissions standards.

The ECM contains an internal Barometric Pressure (BARO) sensor for reference.

The ECM, ACM, and DCU, perform the following functions:

- Provides Reference Voltage (VREF)
- Conditions input signals
- Processes and stores control strategies
- Controls actuators

Doser Control Unit (DCU)

The Electronic Control Module (ECM) communicates with the DCU to control the timing and quantity of fuel sprayed from the hydrocarbon injector assembly.

Reference Voltage (VREF)

The ECM, ACM, and DCU supply 5 volt VREF supply to various input sensors in the electronic control system. The ECM and ACM determine pressures, positions, and other variables important to engine, aftertreatment, and vehicle functions.

Microprocessor

The microprocessor, installed inside the ECM, ACM, and DCU, process stored operating instructions (control strategies) and value tables (calibration parameters). The microprocessor compares stored instructions and values with conditioned input values to determine the correct strategy for all engine operations.

Diagnostic strategies are also programmed into the ECM, ACM, and DCU. Some strategies monitor inputs continuously and command the necessary outputs for correct performance of the engine and aftertreatment.

Diagnostic Trouble Codes

Diagnostic Trouble Codes (DTCs) are stored by the ECM if inputs or conditions do not comply with expected values. Diagnostic fault codes are communicated using the Suspect Parameter Number (SPN) and Failure Mode Indicator (FMI) identifiers, and are accessed using an electronic service tool with ServiceMaxx™ diagnostic software or other J1939 and J1708 RP1210B compliant interface device.

Microprocessor Memory

The ECM and ACM microprocessors includes Read Only Memory (ROM) and Random Access Memory (RAM).

Read Only Memory (ROM)

ROM stores permanent information for calibration tables and operating strategies. Permanently stored information cannot be changed or lost when the ignition switch is turned to OFF or when power to the control modules is interrupted. ROM includes the following:

- Vehicle configuration, modes of operation, and options
- Engine Family Rating Code (EFRC)
- Engine warning and protection modes

Random Access Memory (RAM)

RAM stores temporary information for current engine conditions. Temporary information in RAM is lost when the ignition switch is turned to OFF or power to control module is interrupted. RAM information includes the following:

- Engine temperature
- Engine rpm
- Accelerator pedal position

Actuator Control

Actuators are controlled in one of the following ways, depending upon type of actuator:

- Duty cycle (percent time On / Off)
- Switched On or Off
- CAN messages

ECM Actuators and Sensors

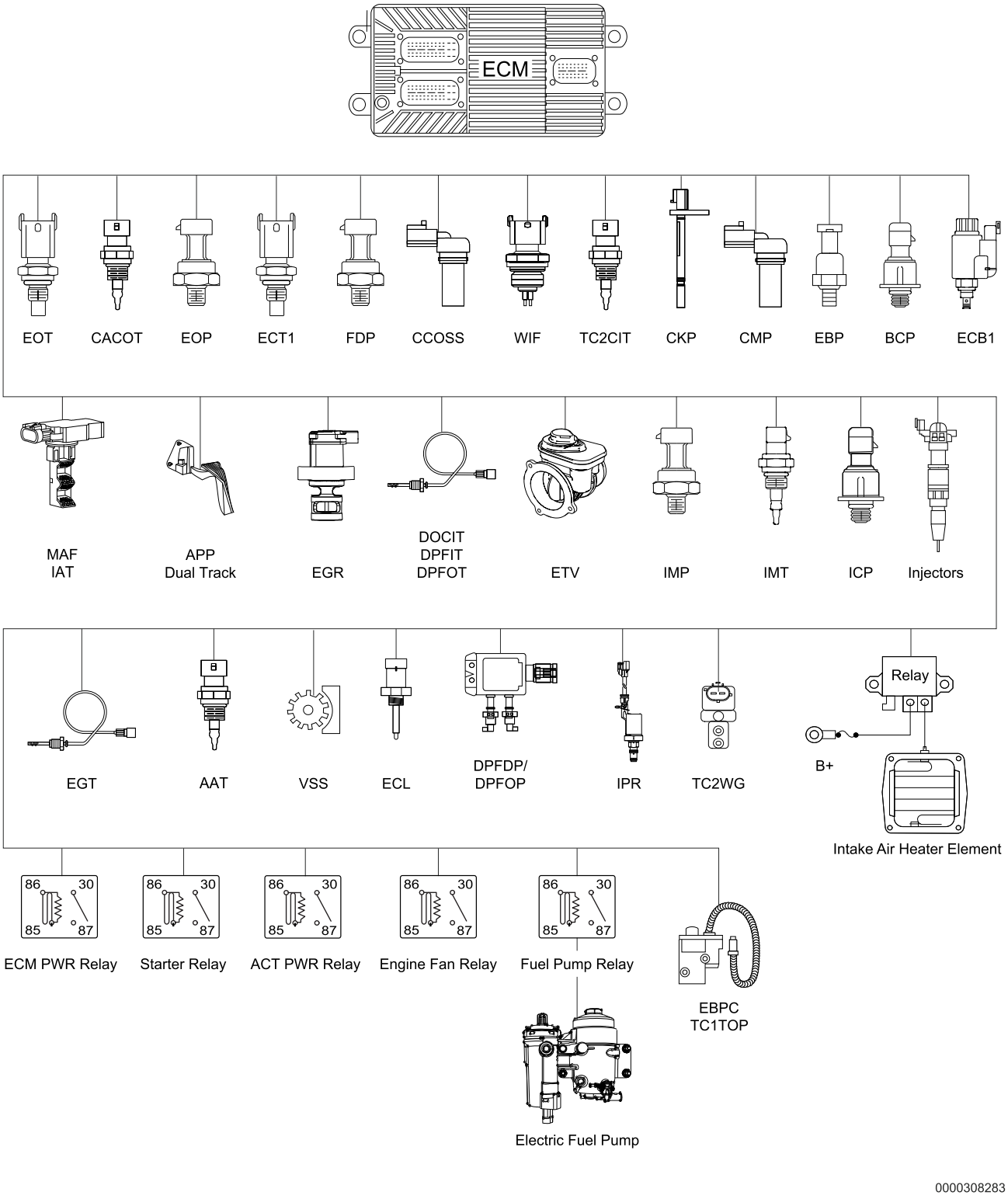


Figure 1192 Electronic Control System

The ECM controls engine operation with the following:

- Exhaust Gas Recirculation Valve (EGRV)
- Intake Air Heater (IAH) system
- Electric Fuel Pump (EFP)
- Engine Throttle Valve (ETV) and Engine Throttle Valve Position (ETP) sensor
- Turbocharger 2 Wastegate (TC2WG) position valve
- Exhaust Back Pressure Control (EBPC)
- Engine Compression Brake Output 1 (ECB1) valve
- Injectors
- Injection Pressure Regulator (IPR) valve

Exhaust Gas Recirculation Valve (EGRV)

The EGR valve controls the flow of exhaust gases to the air and EGR mixer duct. The ECM sends the desired valve position for exhaust gas recirculation to the EGR valve. The EGR Valve Position (EGRP) sensor sends feedback to the ECM. A fault code will be set if the ECM detects an error message from the EGR valve.

Intake Air Heater (IAH) System

The IAH system warms the incoming air supply prior to cranking to aid cold engine starting. The ECM is programmed to energize the IAH element through the IAH relay while monitoring certain programmed conditions for engine coolant temperature, engine oil temperature, and atmospheric pressure. The ECM activates the IAH relay. The relay supplies battery voltage to the heater element for a set time, depending on engine coolant temperature and altitude.

Electric Fuel Pump (EFP)

Electric Fuel Pump (EFP) supplies fuel to engine at approximately 90 psi (620 kPa). Engine Control Module (ECM) drives fuel supply pump directly, using H-Bridge driver.

Fuel Delivery Pressure (FDP) sensor is only capable of measuring up to 75 psi (517 kPa) of pressure, even though fuel pressure normally operates at 90 psi (621 kPa).

Engine Throttle Valve (ETV) and Engine Throttle Valve Position (ETP) Sensor

The ETV controls the flow of intake air to regulate operating temperature for exhaust aftertreatment and base engine operation. The integral throttle actuator controls the engine throttle valve. The throttle actuator is controlled by the ECM to activate the throttle valve. The ETP provides feedback to the ECM on the throttle valve position.

Turbocharger 2 Wastegate (TC2WG) position valve

The turbocharger wastegate actuator regulates the charge air pressure by controlling the amount of exhaust gases that pass through the high-pressure turbine. The TC2WG valve receives the command signal from the ECM. When the charge air pressure demand is low, the TC2WG valve closes the vent circuit, allowing compressor outlet pressure to pass to the wastegate. When the charge air pressure demand is high, the TC2WG vents compressor outlet pressure to the wastegate, closing the wastegate high-pressure turbine.

Exhaust Back Pressure Control (EBPC)

The EBPC is controlled using the Air Control Valve (ACV) assembly. The ACV assembly contains the EBPC control valve, and the Turbocharger 1 Turbine Outlet Pressure (TC1TOP) sensor. Both are used by the ECM to control EBPC operation.

The EBPC regulates air pressure applied to the EBPC pneumatic actuator. The pneumatic cylinder actuates the valve (in the exhaust system) in response to commands by the ECM.

The EBPC actuator is mounted on the right side of the engine, after the turbocharger exhaust connection.

Engine Compression Brake Output 1 (ECB1) valve

The ECB1 valve controls pressure entering the brake oil gallery from the injector oil gallery. This activates the brake actuator pistons and opens the exhaust valves. The ECB1 valve is installed in the center of the high-pressure oil manifold.

Injectors

The injector injects fuel into the cylinders. The Engine Control Module (ECM) controls the timing and the amount of fuel being sprayed from each injector. The ECM also controls the Injection Control Pressure (ICP) system to regulate fuel spray pressure.

Injection Pressure Regulator (IPR) valve

The IPR valve is used to maintain desired injection control pressure. The IPR valve controls the spool valve that throttles the intake to the HPOP.

ACM Actuators

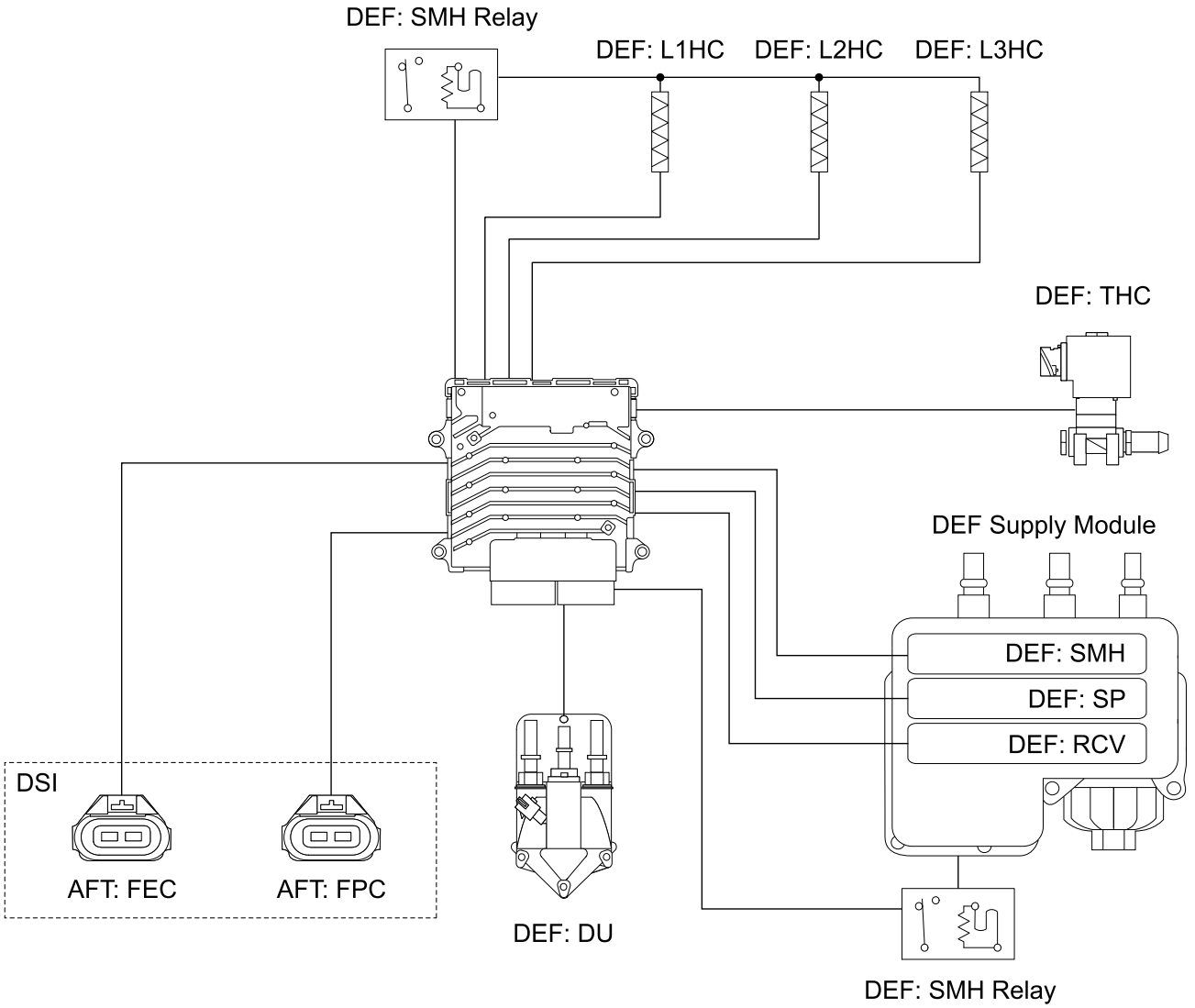


Figure 1193 ACM Actuators

The ACM controls aftertreatment system operation with the following:

- Aftertreatment Fuel Enable Control (AFT: FEC)
- Aftertreatment Fuel Pressure Control (AFT: FPC)
- Diesel Exhaust Fluid Dosing Unit (DEF: DU)
- Diesel Exhaust Fluid Unit Heater Relay (DEF: SMH Relay)
- Diesel Exhaust Fluid Line Heater Relay (DEFLHR)

- DEF Line 1 Heater Control (DEF: L1HC) Supply Line
- DEF Line 2 Heater Control (DEF: L2HC) Return Line
- DEF Line 3 Heater Control (DEF: L3HC) Pressure Line
- Diesel Exhaust Fluid Tank Heater Control (DEF: THC)
- Diesel Exhaust Fluid Supply Module Heater (DEF: SMH)
- Diesel Exhaust Fluid Supply Pump (DEF: SP) and DEF Tank Temperature (DEF: TT) Sensors
- Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV)

Aftertreatment Fuel Enable Control (AFT: FEC)

The AFT: FEC is used to control fuel flow to the doser injector. The AFT: FEC is controlled through an On-Off signal sent by the Aftertreatment Control Module (ACM). The AFT: FEC is installed in the AFT fuel doser module, located to the rear of the fuel filter assembly, on the left side of the engine.

Aftertreatment Fuel Pressure Control (AFT: FPC)

The Aftertreatment Fuel Pressure Control (AFT: FPC) valve regulates fuel to the doser injector when in regen mode.

Diesel Exhaust Fluid Dosing Unit (DEF: DU)

The DEF: DU is a solenoid assembly controlled by the Aftertreatment Control Module (ACM). When the ACM commands DEF dosing, it opens the doser valve and allows DEF to be sprayed into the exhaust stream.

Diesel Exhaust Fluid Unit Heater Relay (DEF: SMH Relay)

The DEF unit heaters are used to maintain proper DEF temperature to avoid DEF freezing. When DEF temperature is too low. The ACM commands the DEF: SMH Relay ON, sending power to the DEF unit heaters.

The DEF: SMH Relay is installed in the Power Distribution Module (PDM), behind the DEF tank.

Diesel Exhaust Fluid Line Heater Relay (DEFLHR)

The DEF line heaters are used to maintain proper DEF temperature to avoid DEF freezing. When DEF temperature is too low. The ACM commands the DEFLHR ON, sending power to the DEF line heaters.

The DEFLHR is installed in the Power Distribution Module (PDM), behind the DEF tank.

DEF Line 1 Heater Control (DEF: L1HC) Supply Line

The DEF: L1HC is used to maintain proper DEF temperature in the DEF supply module suction line.

The DEF: L1HC is wrapped around the suction line between the DEF supply module and DEF tank.

DEF Line 2 Heater Control (DEF: L2HC) Return Line

The DEF: L2HC is used to maintain proper DEF temperature in the DEF supply module return line.

The DEF: L2HC is wrapped around the return line return line

DEF Line 3 Heater Control (DEF: L3HC) Pressure Line

The DEF: L3HC is used to maintain proper DEF temperature in the DEF supply module pressure line.

The DEF: L3HC is wrapped around the pressure line between the DEF supply module and DEF: DU.

Diesel Exhaust Fluid Tank Heater Control (DEF: THC)

The DEF: THC controls coolant flow to the DEF tank. When DEF temperature is low, the ACM commands the DEFTHV open, allowing coolant flow to warm the DEF tank.

The DEF: THC is typically mounted to the vehicle frame.

Diesel Exhaust Fluid Supply Module Heater (DEF: SMH)

The Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) and DEF Reverting Control Valve (DEF: RCV) receive coolant from a supply line running from the lower radiator hose. When DEF tank temperature is too low, the Aftertreatment Control Module (ACM) commands the DEF: RCV ON allowing coolant to pass through the DEF tank heating coil. Coolant from the DEF tank heating coil and DEF: RCV then returns to the water pump intake through a coolant return line.

Diesel Exhaust Fluid Supply Pump (DEF: SP) and DEF Tank Temperature (DEF: TT) Sensors

The DEF: SP is controlled using a Pulse Width Modulated (PWM) signal from the ACM.

The DEF supply module has an internal temperature sensor (DEF: TT) used to monitor DEF: SP temperature.

The DEF: SP is part of the DEF supply module, and is not serviceable individually.

Diesel Exhaust Fluid Reverting Control Valve (DEF: RCV)

The Diesel Exhaust Fluid Supply Module Heater (DEF: SMH) and DEF Reverting Control Valve (DEF: RCV) receive coolant from a supply line running from the lower radiator hose. When DEF tank temperature is too low, the Aftertreatment Control Module (ACM) commands the DEF: RCV ON allowing coolant to pass through the DEF tank heating coil. Coolant from the DEF tank heating coil and DEF: RCV then returns to the water pump intake through a coolant return line.

Engine and Vehicle Sensors

Engine Temperature Sensors

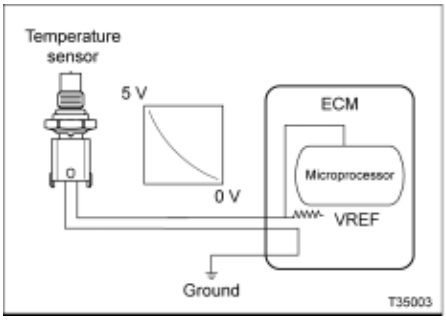


Figure 1194 Thermistor Sensor

A thermistor sensor changes electrical resistance with changes in temperature. As temperature changes at the thermistor, voltage at the ECM, ACM, or DCU will change accordingly. Thermistors work with the control module to produce a voltage signal inversely proportional to temperature values.

A thermistor sensor has two electrical terminals, signal and signal ground. The output of a thermistor sensor is a non-linear analog signal.

Thermistor type sensors include the following:

- Engine Coolant Temperature 1 (ECT1) sensor
- Engine Oil Temperature (EOT) sensor
- Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor
- Exhaust Gas Temperature (EGT)
- Charge Air Cooler Outlet Temperature (CACOT) sensor
- Intake Air Heater (IAT) sensor
- Intake Manifold Temperature (IMT) sensor
- Ambient Air Temperature (AAT) sensor

Engine Coolant Temperature 1 (ECT1) Sensor

The ECT1 sensor is a thermistor-type sensor that measures engine coolant temperature.

The ECT1 signal is monitored by the ECM for operation of the instrument panel temperature gauge, coolant temperature compensation, charge air temperature control, EGR system control, optional Engine Warning Protection System (EWPS), and the Wait to Start lamp. The ECM uses ECT1 sensor input as a backup, if EOT sensor values are out of range.

The ECT1 sensor is installed in the underside of the EGR coolant crossover manifold, at the back of the engine.

Engine Oil Temperature (EOT) Sensor

The ECM monitors the EOT signal and uses this information to control fuel quantity and timing. The EOT signal allows the ECM to compensate for differences in oil viscosity for temperature changes. The EOT sensor is installed in the rear of the front cover, to the left of the high-pressure pump assembly.

Turbocharger 2 Compressor Intake Temperature (TC2CIT) Sensor

The TC2CIT sensor monitors the temperature of the air entering the Turbocharger 2 compressor. The ECM monitors the TC2CIT signal to evaluate the effectiveness and condition of the interstage cooler.

The Aftertreatment System and exhaust manifold use the following sensors:

- Exhaust Gas Temperature (EGT) sensor

Exhaust Gas Temperature (EGT) Sensor

The EGT sensor used in the exhaust manifold provides a feedback signal to the ECM indicating exhaust gas temperature.

Charge Air Cooler Outlet Temperature (CACOT) Sensor

The CACOT sensor monitors the temperature of the air leaving the CAC. The ECM monitors the CACOT signal to evaluate the effectiveness and condition of the CAC.

Intake Air Heater (IAT) Sensor

CONTENT
UNDER
DEVELOPMENT

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Contents under development

Intake Manifold Temperature (IMT) Sensor

The IMT sensor is a thermistor sensor that monitors temperature.

The IMT sensor is installed in the intake side of the cylinder head, on the left side of the engine.

Ambient Air Temperature (AAT) Sensor

The AAT sensor is a thermistor sensor that detects the temperature of ambient air.

The AAT signal is monitored by the ECM.

The AAT sensor is installed in various places depending on the vehicle.

Aftertreatment Temperature Sensors

Temperature sensors used in the Aftertreatment System include the following:

- Diesel Exhaust Fluid Tank Level and Temperature (DEF: TLT) sensor
- Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module
  - Diesel Oxidation Catalyst Intake Temperature (DOCIT) sensor
  - Diesel Particulate Filter Intake Temperature (DPFIT) sensor
  - Diesel Particulate Filter Outlet Temperature (DPFOT) sensor
- Selective Catalyst Reduction (SCR) Temperature Sensor Module
  - Selective Catalyst Reduction Intake Temperature (SCRIT) sensor
  - Selective Catalyst Reduction Outlet Temperature (SCROT) sensor

Diesel Exhaust Fluid Tank Level and Temperature (DEF: TLT) Sensor Module

The DEF: TLT sensor module is a combination sensor that monitors DEF tank level and temperature, and communicates to the Aftertreatment Control Module (ACM) through J1939 Controller Area Network (CAN) communication.

The DEF: TLT sensor module is installed inside the DEF tank.

Diesel Oxidation Catalyst (DOC) / Diesel Particulate Filter (DPF) Temperature Sensor Module

The DOC / DPF temperature sensor module monitors aftertreatment DPF and DOC temperature. The DOC / DPF temperature sensor module monitors signals from the DOC Intake Temperature (DOCIT), DPF Intake Temperature (DPFIT), and DPF Outlet Temperature (DPFOT) sensors, and communicates these signals to the Aftertreatment Control Module (ACM) through J1939 Controller Area Network (CAN) communication.

The DOCIT, DPFIT, and DPFOT sensors are not serviceable individually, and are part of the DOC / DPF temperature sensor module.

Diesel Oxidation Catalyst Intake Temperature (DOCIT) Sensor

The DOCIT sensor provides a feedback signal to the ACM indicating Diesel Oxidation Catalyst (DOC) intake temperature. The DOCIT sensor is the first temperature sensor installed past the turbocharger and just before the DOC.

Diesel Particulate Filter Intake Temperature (DPFIT) Sensor

The DPFIT sensor provides a feedback signal to the ACM indicating Diesel Particulate Filter (DPF) intake temperature. The DPFIT sensor is the second temperature sensor installed past the turbocharger and just after the DOC.

Diesel Particulate Filter Outlet Temperature (DPFOT) Sensor

The DPFOT sensor provides a feedback signal to the ACM indicating DPF outlet temperature. The DPFOT sensor is the third temperature sensor installed past the turbocharger and just after the DPF. During a catalyst regeneration, the ECM monitors all three sensors along with the Exhaust Gas Recirculation (EGR) System and Engine Throttle Valve (ETV).

Selective Catalyst Reduction (SCR) Temperature Sensor Module

The SCR temperature sensor module monitors aftertreatment SCR catalyst temperature. The SCR temperature sensor module monitors signals from the SCR Intake Temperature (SCRIT) sensor, and SCR Outlet Temperature (SCROT) sensor, and communicates these signals to the ACM through J1939 Controller Area Network (CAN) communication.

The SCRIT sensor and SCROT sensor are not serviceable individually, and are part of the SCR temperature sensor module.

Variable Capacitance Sensors

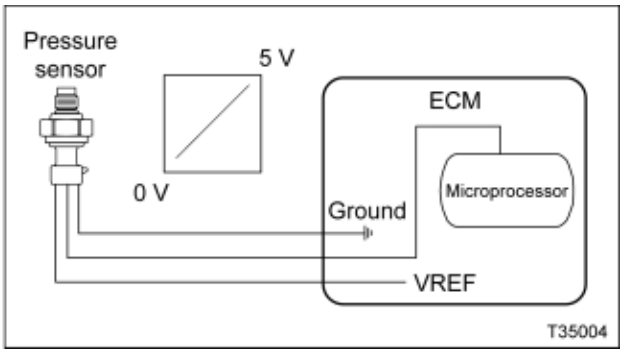


Figure 1196 Variable Capacitance Sensor

Variable capacitance sensors measure pressure. The pressure measured is applied to a ceramic material. Pressure forces the ceramic material closer to a thin metal disk. This action changes the capacitance of the sensor.

The sensor is connected to the control module through the VREF, signal, and signal ground wires.

The sensor is powered by VREF and returns an analog signal voltage to the Engine Control Module (ECM) or Aftertreatment Control Module (ACM). The ECM, ACM, and DCU compares the voltage with pre-programmed values to determine pressure.

Variable capacitance sensors include the following:

- Fuel Delivery Pressure (FDP) sensor
- Engine Oil Pressure (EOP) sensor
- Exhaust Back Pressure (EBP) sensor
- Mass Air Flow (MAF) sensor
- Intake Manifold Pressure (IMP) sensor
- Aftertreatment Fuel Pressure 1 (AFT: FP1) sensor
- Aftertreatment Fuel Temperature (AFT: FT) sensor
- Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor
- Diesel Exhaust Fluid Absolute Pressure (DEFAP) sensor
- Diesel Particulate Filter Differential Pressure (DPFDP) / DPF Outlet Pressure (DPFOP) sensor
- Turbocharger 1 Turbine Outlet Pressure (TC1TOP) sensor

Fuel Delivery Pressure (FDP) sensor

The FDP sensor is a variable capacitance sensor that measures fuel supply pressure.

The FDP sensor provides feedback to the ECM for the low-pressure fuel system.

The FDP sensor is installed in the front of the fuel filter assembly on the left side of the engine.

Engine Oil Pressure (EOP) Sensor

The EOP sensor is a variable capacitance sensor that detects engine oil pressure.

The EOP signal is monitored by the ECM for operation of the instrument panel pressure gauge and optional Engine Warning and Protection System (EWPS).

The EOP sensor is installed in the oil module, on the left side of the engine.

Exhaust Back Pressure (EBP) Sensor

The ECM monitors the exhaust pressure to control the EGR and intake throttle systems. The EBP sensor is installed in a tube mounted on the coolant supply housing (refrigerant compressor bracket).

Mass Air Flow (MAF) Sensor

The MAF sensor is used for closed loop control of the EGR valve and ETV. The ECM monitors the MAF signal to control the EGR and intake throttle systems. The MAF sensor assembly includes the IAT sensor which sends air temperature information to the ECM.

The MAF sensor is installed in the intake air duct or air cleaner housing.

Intake Manifold Pressure (IMP) Sensor

The IMP sensor is a variable capacitance sensor that monitors the pressure of charge air entering the intake manifold.

The IMP signal is monitored by the ECM for control of the EGR system and turbocharger wastegate.

The IMP sensor is installed in the intake manifold, after the Engine Throttle Valve (ETV).

Aftertreatment Fuel Pressure 1 (AFT: FP1) sensor

The AFT: FP1 sensor is a variable capacitance sensor that the ACM uses to monitor fuel pressure into the aftertreatment system between the AFT: FEC and AFT: FPC valves.

The AFT: FP1 sensor is installed in the AFT fuel doser module, to the rear of the fuel filter assembly.

Aftertreatment Fuel Temperature (AFT: FT) sensor

The AFT: FP2 sensor is a thermistor that measures fuel temperature at the doser metering unit.

The AFT: FP1 and AFT: FT sensors are part of the same assembly.

Aftertreatment Fuel Pressure 2 (AFT: FP2) sensor

The AFT: FP2 sensor is a variable capacitance sensor that monitors fuel pressure after the AFT : PC valve.

The AFT: FP2 sensor is located in the DSI unit.

Diesel Exhaust Fluid Absolute Pressure (DEFAP) sensor

The DEFAP signal is a CAN message from the ACM.

The DEFAP is part of the DEF supply module, and is not serviceable individually.

Diesel Particulate Filter Differential Pressure (DPFDP) / DPF Outlet Pressure (DPFOP) sensor

The DPFDP / DPFOP sensor provides a feedback signal to the ACM indicating the pressure difference between the intake and outlet of the DPF.

The DPFDP / DPFOP sensor is a differential pressure sensor with two tap-offs installed at the DPF. A tap-off is installed before and after the DPF.

Turbocharger 1 Turbine Outlet Pressure (TC1TOP)

The TC1TOP sensor is a variable capacitance sensor that measures the exhaust pressure after the turbines.

The sensor measures pressure in the exhaust system. A tap for the TC1TOP is installed in the exhaust, between the low-pressure turbine and Exhaust Back Pressure Valve (EBPV).

The TC1TOP sensor is installed in the Air Control Valve (ACV), on the right side of the engine.

High-pressure Sensors

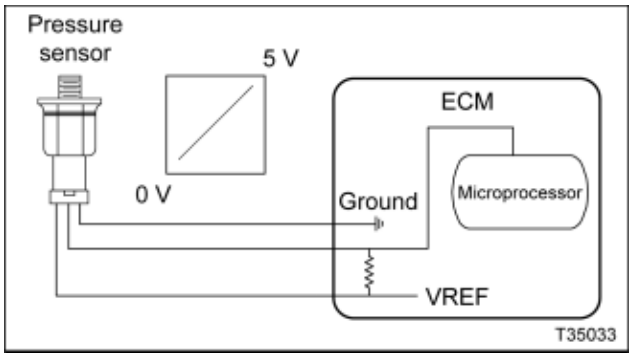


Figure 1197 High-Pressure Sensor

High-pressure sensors convert pressure to a linear analog voltage output of 0 to 5 volts. The pressure causes a strain on the diaphragm with a strain gauge bonded to it. This sensor has three wires: VREF, signal ground, and a signal wire. The sensor is powered by VREF from the ECM and is grounded through the ECM to a common signal ground. The ECM compares the voltage with pre-programmed values to determine pressure.

High-pressure sensors include the following:

- Brake Control Pressure (BCP) sensor
- Injection Control Pressure (ICP) sensor

Brake Control Pressure (BCP) Sensor

The ECM monitors the BCP sensor signal to determine oil pressure in the brake gallery of the high-pressure oil manifold. The BCP sensor is under the valve cover, forward of the No. 2 fuel injector in the high-pressure oil manifold. The BCP sensor is optional.

Injection Control Pressure (ICP) Sensor

The ECM measures the ICP sensor to determine injection control pressure for engine operation. The ICP sensor is used to control the IPR valve. It provides feedback to the ECM for closed loop high-pressure oil control. The ICP sensor is located under the valve cover, forward of the No. 6 fuel injector in the high-pressure oil manifold.

Magnetic Pickup Sensors

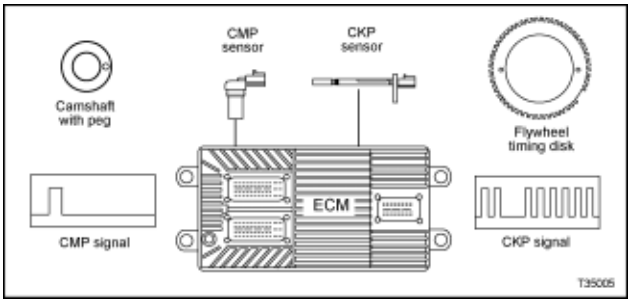


Figure 1198 Magnetic Pickup Sensor

A magnetic pickup sensor contains a permanent magnet, a ferromagnetic pole piece, and a magnetic pickup. The VRS generates an AC voltage signal that is proportional to the change in flux at the magnetic pickup as a metal trigger wheel passes along the sensor

Magnetic pickup sensors used include the following:

- Crankshaft Position (CKP) sensor
- Camshaft Position (CMP) sensor
- Vehicle Speed Sensor (VSS)
- Crankcase Oil Separator Speed (CCOSS) sensor

Crankshaft Position (CKP) Sensor

The CKP sensor is a variable reluctance sensor that indicates crankshaft speed and position.

The CKP sensor sends a varying AC signal to the Engine Control Module (ECM) as the crankshaft turns. The CKP sensor generates an AC pulse for each tooth on the 60 minus 2 crankshaft timing wheel at the rear of the crankshaft. The minus 2 gap in the crankshaft timing wheel and the CMP sensor signal are used to determine engine position for synchronization. The time between CKP sensor pulses is used to calculate engine RPM. The offset of CKP pulses from the reference position is used to determine engine timing for injection events.

The CKP sensor is installed in the top left of the flywheel housing.

Camshaft Position (CMP) Sensor

The CMP sensor is a magnetic pickup sensor that indicates camshaft speed and position.

The CMP sensor sends a single AC signal to the ECM as a once per camshaft rotation as a peg on the camshaft rotates past the CMP sensor.

The CMP sensor is installed in the left rear of the cylinder head.

Vehicle Speed Sensor (VSS)

The VSS provides the ECM with transmission tail shaft speed by sensing the rotation of a 16-tooth rotor on the rear of the transmission or a CAN signal from the TCM. The detected signal (AC) received by the ECM, is used with tire size and axle ratio to calculate vehicle speed. The VSS is installed on the left side of the transmission housing for automatic transmissions, or at rear of the transmission housing for manual transmissions.

Crankcase Oil Separator Speed (CCOSS) Sensor

The CCOSS sensor sends the ECM information about the speed of the crankcase oil separator internal components. The detected signal (AC) received by the ECM is used to monitor operation of the cyclonic oil separator, installed inside the breather assembly on the engine oil filter assembly.

Switches

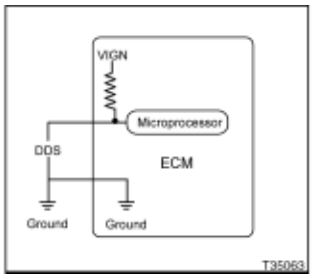


Figure 1199 Switch

Switch sensors indicate position, level, or status. They operate open or closed, regulating the flow of current. A switch sensor can be a voltage input switch or a grounding switch. A voltage input switch supplies the ECM with a voltage when it is closed. A grounding switch grounds the circuit when closed, causing a zero voltage signal. Grounding switches are usually installed in series with a current limiting resistor.

Switch sensors include the following:

- Driveline Disengagement Switch (DDS)
- Engine Coolant Level (ECL) Sensor
- Water In Fuel (WIF)

Driveline Disengagement Switch (DDS)

The DDS determines if a vehicle is in gear. For manual transmissions, the clutch switch serves as the DDS. For automatic transmissions, the neutral indicator switch functions as the DDS. The DDS signal is sent to the Body Controller (BC) and transmitted on the J1939 Controller Area Network (CAN) datalink to the engine ECM.

Engine Coolant Level (ECL) Sensor

ECL sensor is part of the Engine Warning and Protection System (EWPS). The ECL switch is installed on the deaeration tank.

When engine coolant is normal, ECL measures 0 volts, switch opens and ENGINE lamp on the instrument panel is off. If engine coolant is low, ECL voltage is "logic high", switch closes and red ENGINE lamp on instrument panel is illuminated.

Water In Fuel (WIF)

A Water In Fuel (WIF) sensor in the fuel filter assembly is used to detect water in the fuel. The resistance of the WIF sensor circuit changes when the water level in the fuel filter assembly reaches the sensor. The ECM then sends a message to illuminate the amber water-in-fuel lamp, alerting the operator.

WIF is installed in the side of the fuel filter assembly.

Potentiometer Sensors

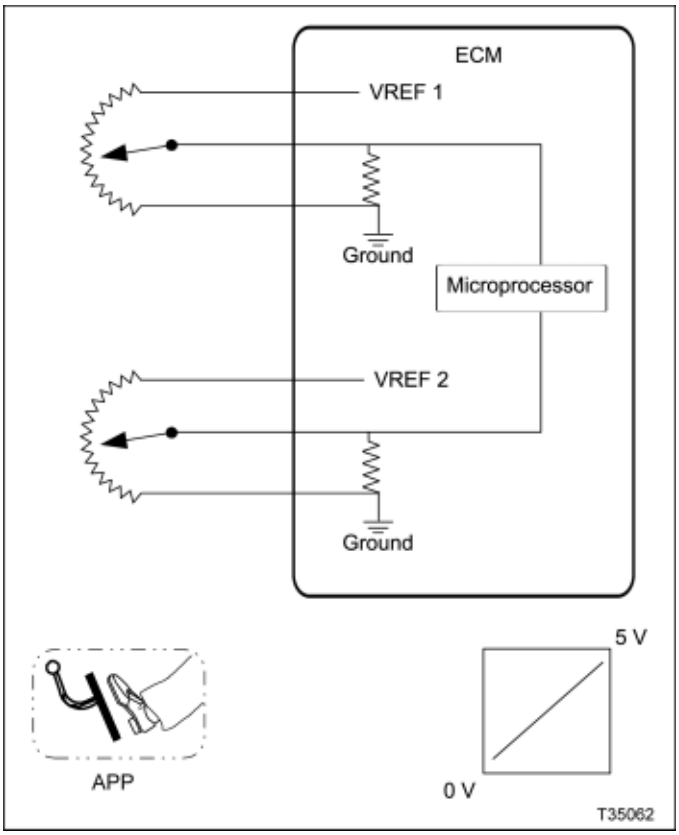


Figure 1200 Potentiometer

A potentiometer is a variable voltage divider that senses the position of a mechanical component. A reference voltage is applied to one end of the potentiometer. Mechanical rotary or linear motion moves the wiper along the resistance material, changing voltage at each point along the resistive material. Voltage is proportional to the amount of mechanical movement.

The engine has two potentiometers, both contained in the Accelerator Pedal Position (APP) Sensor.

Accelerator Pedal Position (APP)

APP provides the ECM with a dual feedback signal (dual linear analog voltages) that indicate the operator's demand for power. APP contains two potentiometers, and provides two individual signals (APP1 and APP2) to the ECM. APP is installed in the cab on the accelerator pedal assembly.

Engine Throttle Valve Control System

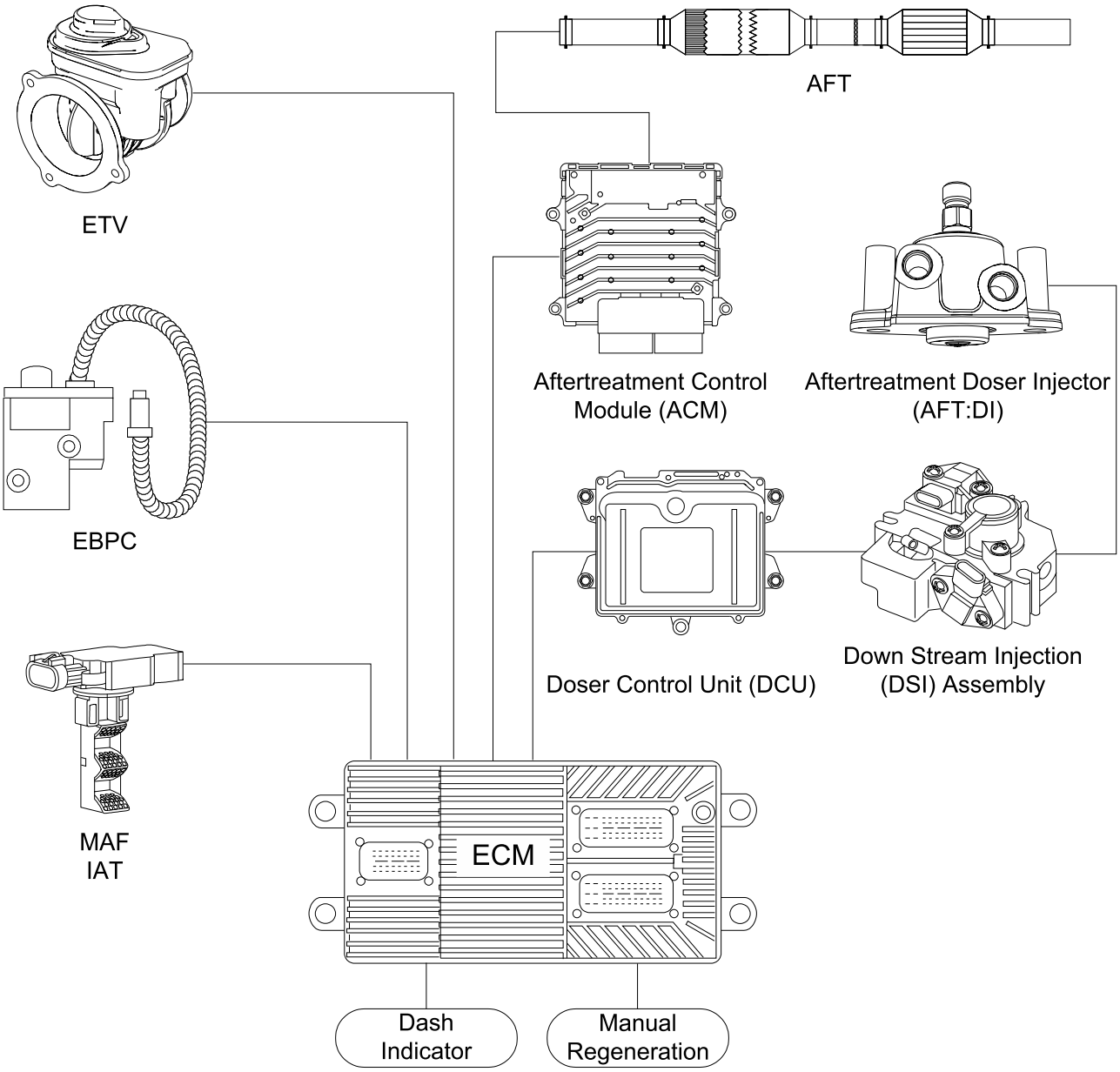


Figure 1201 Engine Throttle Valve Control System

The Engine Throttle Valve (ETV) is controlled to limit intake air. As part of the air management system, the ETV is controlled by the ECM (closed loop) based on input from the Mass Air Flow (MAF) sensor for proper emissions control.

The ETV is also used to help control intake air during a Diesel Particulate Filter (DPF) regeneration process of the aftertreatment system. It maintains vehicle and engine performance during regenerations.

Exhaust and Engine Brake System

Exhaust Brake

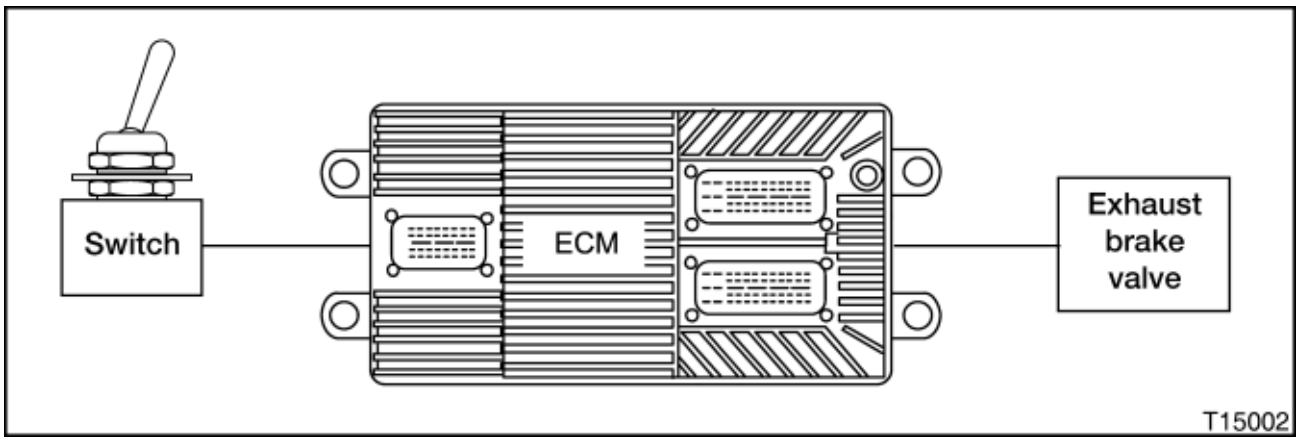


Figure 1202 Exhaust Brake System

The exhaust brake is available for all ratings and aids in the deceleration rate of vehicles.

The exhaust brake is an exhaust back pressure brake system that provides improved braking performance.

The operator can enable the brake function by toggling an instrument panel mounted switch ON or OFF.

Engine Brake

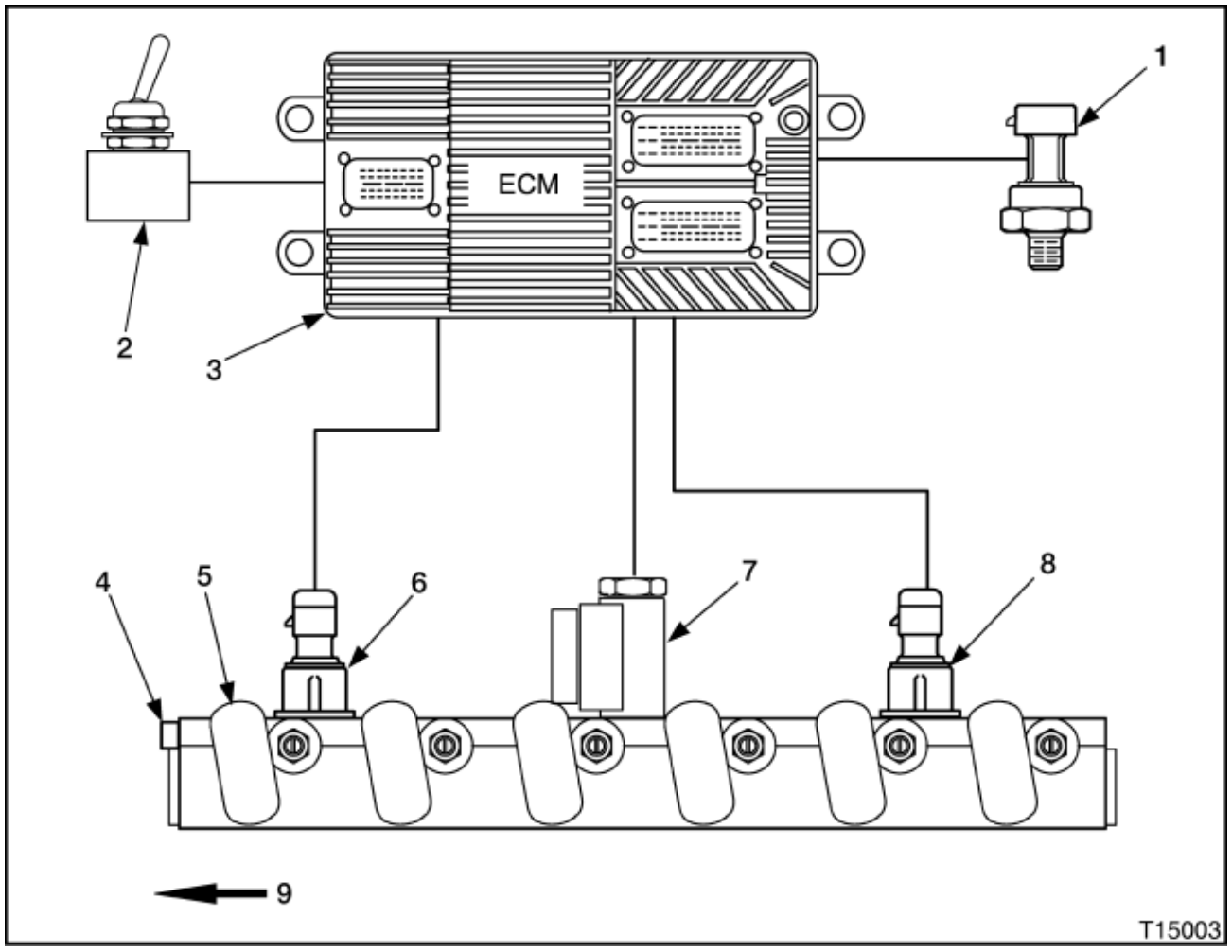


Figure 1203 Engine Brake

1. Exhaust Back Pressure (EBP) sensor
2. Switch
3. Electronic Control Module (ECM)
4. Brake pressure relief valve
5. High-pressure oil manifold
6. Engine Compression Brake Pressure (ECBP) sensor
7. Engine Compression Brake (ECB) valve
8. Injection Control Pressure (ICP) sensor
9. Front of engine

Exhaust Back Pressure Control (ECBC)

The Engine Control Module (ECM) (Figure 1203) (Item 3)monitors the ECBC (Figure 1203) (Item 4) signal during engine normal and braking operation to determine if the engine brake system is working without fault. The ECBC sensor provides a feedback signal to the ECM indicating brake control pressure.

The ECBC sensor is installed in the high-pressure oil manifold, under the valve cover.

Engine Compression Brake Output 1 (ECB1)

The ECB valve (Figure 1203) (Item 7) controls pressure entering the brake oil gallery from the injector oil gallery. This activates the brake actuator pistons and opens the exhaust valves.

The ECB valve is installed in the center of the high-pressure oil manifold (Figure 1203) (Item 5).

Brake Pressure Relief Valve

The brake pressure relief valve (Figure 1203) (Item 4) vents excess pressure under the valve cover. Residual brake gallery pressure initially bleeds from the actuator bore. When brake gallery pressure reaches a set point, the brake pressure relief valve opens and oil drains back to the sump.

Exhaust Back Pressure (EBP) Sensor

The EBP sensor (Figure 1203) (Item 1) is an input to the ECM (Figure 1203) (Item 3) for control of the Turbocharger 2 Wastegate Valve (TC2WG) valve. The TC2WG valve controls the turbocharger wastegate actuator. The EBP sensor is mounted on a tube plumbed to the exhaust manifold on the exhaust side of the engine.

High-pressure Oil Manifold

The high-pressure oil manifold (Figure 1203) (Item 5) has two internal separated oil galleries. The manifold supplies high-pressure oil to each fuel injector during normal operation. High-pressure oil is directed to the brake pistons during engine brake operation.

Operation

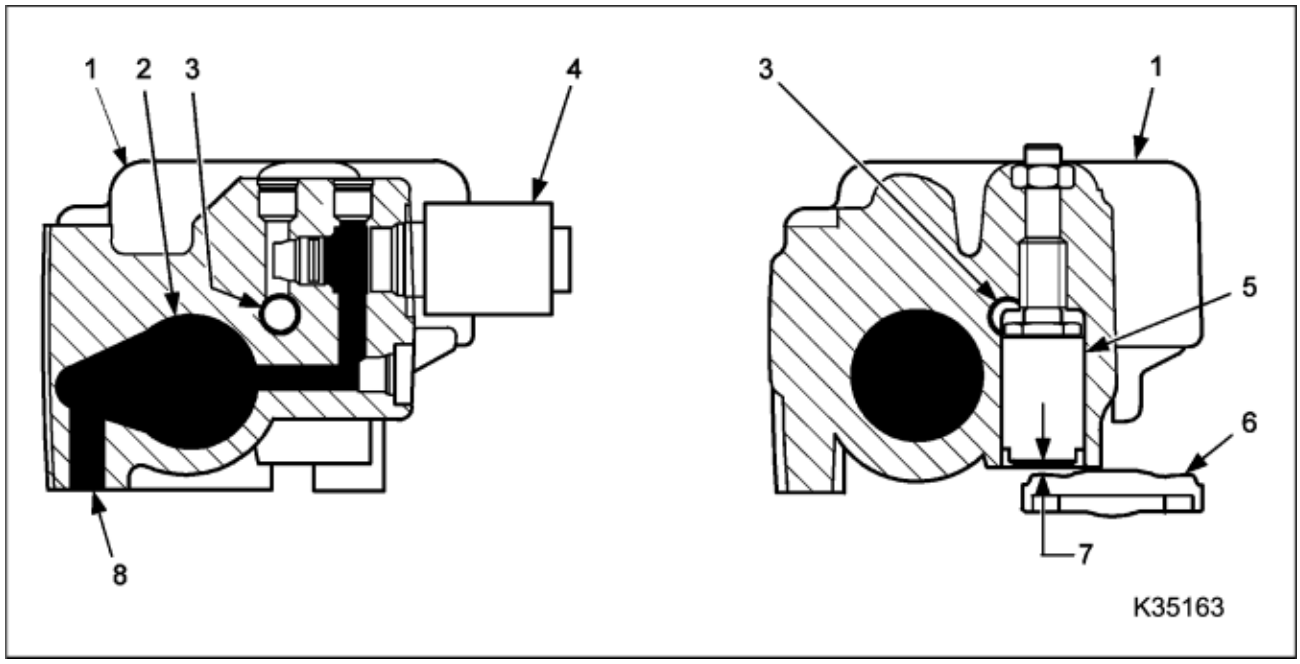


Figure 1204 Engine compression brake valve and brake actuator – OFF

1. High-pressure oil manifold
2. High-pressure oil gallery
3. Brake oil gallery
4. Engine compression brake valve
5. Brake actuator piston assembly
6. Exhaust valve bridge
7. Valve lash (actuator retracted)
8. Oil intake

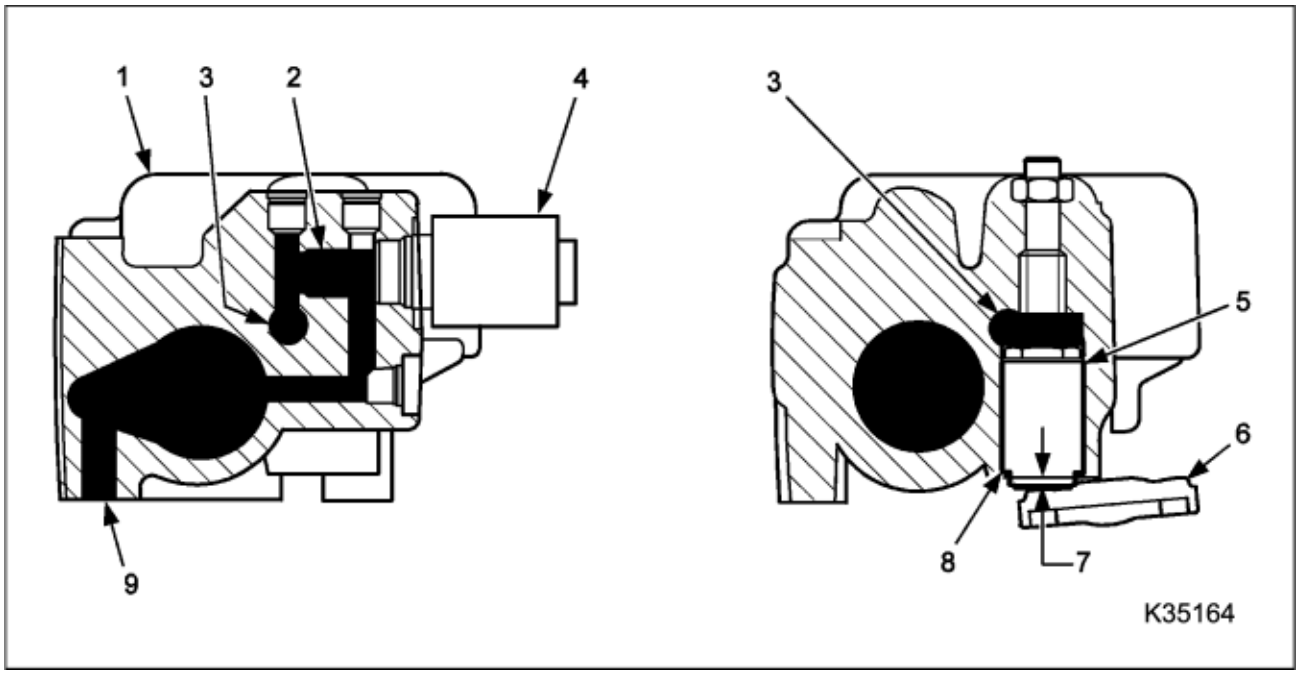


Figure 1205 Engine compression brake valve and brake actuator – OFF

1. High-pressure oil manifold
2. High-pressure oil flow to brake oil gallery
3. Brake oil gallery
4. Engine compression brake valve
5. Brake actuator piston assembly
6. Exhaust valve bridge
7. Valve lash (actuator retracted)
8. Normal oil seepage
9. Oil intake

During engine brake operation, The Engine Compression Brake (ECB) valve (Figure 1204) (Item 4) opens to supply high-pressure oil to each brake actuator piston (Figure 1204) (Item 5). These brake actuator pistons hold the exhaust valves partially open.

During normal engine operation, oil in the high-pressure manifold (Figure 1204) (Item 1) goes to the fuel injectors only. The engine compression brake valve, mounted in the high-pressure oil manifold, is closed to prevent oil from entering the brake oil gallery (Figure 1204) (Item 3).

The Engine Control Module (ECM) monitors the following criteria to make sure certain conditions are met:

- Anti-lock Brake System (ABS) (inactive)
- RPM (greater than 1200)
- Accelerator Pedal Position (APP) (less than 5%)
- Engine Oil Temperature (EOT) (greater than or equal to 140°F [60°C])
- Operator input switches (On / Off)

If On is selected, and the preceding criteria are met, the engine brake will activate.

When the engine brake is activated, the ECM provides the power to activate the Engine Compression Brake (ECB) valve to allow oil from the injector oil gallery to flow to the brake oil gallery (Figure 1205) (Item 3) . High oil pressure activates the brake actuator pistons to open the exhaust valves.

Vehicle momentum is absorbed by the resulting compression release of the engine power cylinders when pistons are near the top of their stroke.

During an ABS event, the engine brake is deactivated. The engine brake is reactivated once the ABS event is over.

The ECM removes the power source from the ECB valve (Figure 1205) (Item 4) to deactivate the engine brake. Residual brake gallery pressure initially bleeds from the actuator bore. When brake gallery pressure bleeds down the brake pressure relief valve opens, and oil drains back to sump.

Operation Modes

The engine brake system provides three programmable modes of operation based on terrain, driving conditions, or driver preference.

Coast Mode

When the coast mode is programmed, the brake system will activate only when the driver applies the vehicle service brake. The coast mode allows the vehicle to coast without automatic brake system activation.

Latched Mode

When the latch mode is programmed, the brake system will activate when the driver releases the accelerator pedal. The brake system will deactivate when the driver depresses the accelerator or clutch pedals. The brake system will also deactivate when the engine speed is below a pre-programmed rpm.

Cruise Mode

When the cruise mode is programmed, the brake system performs similar to latch mode under normal driving conditions. When cruise control is used the brake system will activate when the vehicle travels down a grade. The brake system helps the cruise control system maintain the set vehicle speed.

Chassis Mounted Features

Charge Air Cooler (CAC)

A Charge Air Cooler (CAC) is an air-to-air heat exchanger, which reduces the temperature of the air charge.

The Aftertreatment System, part of the larger exhaust system, processes engine exhaust to meet tailpipe emission requirements.

- The Diesel Oxidation Catalyst (DOC) oxidizes carbon monoxide, hydrocarbons, and small amounts of nitrogen oxide in the exhaust stream.
- The Diesel Particulate Filter (DPF) captures and oxidizes particulates in the exhaust stream and stores non-combustible ash.

Additional Sensors

Ammonia (NH_3) Sensor Module

The NH_3 sensor module is used to control DEF dosing by monitoring ammonia levels at the Selective Catalyst Reduction (SCR) catalyst.

The NH_3 sensor module monitors the NH_3 sensor signal, and communicates this signal to the Aftertreatment Control Module (ACM).

The NH_3 sensor is not serviceable individually, and is part of the NH_3 sensor module.

Nitrogen Oxides (NOx) IN Sensor Module

Nitrogen Oxides (NOx) IN sensor module is a smart device used to measure the NOx emissions at the intake of the aftertreatment system. The NOx IN sensor module performs internal diagnostics and reports malfunctions back to the ACM using the J1939 CAN data link.

NOx IN sensor is not serviceable individually, and is part of the NOx IN sensor module.

Nitrogen Oxides (NOx) OUT Sensor Module

The Nitrogen Oxides (NOx) OUT sensor module is a smart device used to measure NOx emissions at the outlet of the SCR catalyst. The NOx OUT sensor module performs internal diagnostics and reports malfunctions back to the ACM using the J1939 CAN data link.

NOx OUT sensor is permanently attached to the NOx control module. They are not serviceable independently and it is a single component.

Oxygen Sensor (O_2S)

CONTENT
UNDER
DEVELOPMENT

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Content under development.

Humidity Sensor (HS)

CONTENT UNDER DEVELOPMENT

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Content under development.

Relays

CONTENT
UNDER
DEVELOPMENT

0000305681

ECM Power Relay

CONTENT UNDER DEVELOPMENT

0000305681

Content under development.

Actuator Power Relay

CONTENT
UNDER
DEVELOPMENT

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Content under development.

Engine Fan Relay

CONTENT
UNDER
DEVELOPMENT

0000305681

Content under development.

Fuel Pump Relay

ECM controls Electric Fuel Pump (EFP); the ECM uses a low side driver to supply a ground signal to close the main contacts of the fuel pump relay. The fused electrical power is supplied to the electric fuel pump by the fuel pump relay main contacts.

Fuel Heater Relay

CONTENT
UNDER
DEVELOPMENT

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Content under development.

Starter Relay

CONTENT UNDER DEVELOPMENT

0000305681

Content under development.

Heavy Duty On Board Diagnostics (HD-OBD) Description

Overview

The Environmental Protection Agency (EPA) and Air Research Board (ARB) has added new regulations for 2010 to reduce heavy duty vehicle emissions. The HD-OBD system is designed specifically for electronically controlled heavy duty engines. The goal for HD-OBD regulation is to keep engine emissions within specification for as long as a given vehicle is in use.

HD-OBD is legislated to be implemented in the three following phases:

- 2010: First engine for each Original Equipment Manufacturer (OEM) becomes fully certified.
- 2013: One engine in each engine family becomes fully certified.
- 2016: All engines must be fully HD-OBD certified.

The HD-OBD system continuously monitors for proper engine operation, and will alert the vehicle operator to emission-related faults using the Malfunction Indicator Lamp (MIL). The MIL is installed in the Electronic Instrument Cluster. When a detected emissions fault occurs, the MIL will be illuminated. Diagnostic information is also stored in the Engine Control Module (ECM), and may be accessed by the technician for diagnosis and repair of the malfunction. Diagnostic information is accessed by connecting the Electronic Service Tool (EST) to the in-cab Diagnostic Connector.

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Standard Electronic Control Features

Aftertreatment (AFT) System

The engine and vehicle exhaust piping includes an AFT system to capture soot and other particulates before they exit the exhaust pipe. The soot is captured by the Diesel Particulate Filter (DPF) and is periodically converted to carbon dioxide (CO_2), nitrogen (N), and water vapor (H_2O) by a regeneration (Regen) process.

The AFT system also includes Selective Catalytic Reduction (SCR) subsystems that use Diesel Exhaust Fluid (DEF) injected into the exhaust to reduce tailpipe emissions of Oxides of Nitrogen (NO_X).

Intake Air Heater

The Intake Air Heater (IAH) system warms the incoming air supply to aid in cold engine starting and reduce white smoke during warm-up. The Engine Control Module (ECM) controls the intake air heater and monitors the engine temperature. When the engine is ready for cranking, the ECM sends a message to shut off the WAIT TO START lamp.

Coolant Temperature Compensation (CTC)

CTC reduces fuel delivery if the engine coolant temperature is above cooling system specifications.

Before standard engine warning or optional warning / protection systems engage, the ECM begins reducing fuel delivery when the engine coolant temperature reaches approximately 225°F (107°C). A rapid reduction of 20 percent is commanded when engine coolant temperature reaches approximately 230°F (110°C).

CTC is disabled in emergency vehicles and school buses that require 100-percent power on demand.

Electronic Speedometer and Tachometer

The engine control system calibrates vehicle speed up to 157 pulses per mile. Any new speed calibration information must be programmed with an Electronic Service Tool (EST).

The tachometer signal is generated by the ECM by computing signals for the Camshaft Position (CMP) sensor and Crankshaft Position (CKP) sensor. Calculations for each sensor are sent to the instrument panel.

Engine Crank Inhibit (ECI)

ECI will not allow the starting motor to crank when the engine is running or the automatic transmission is in gear.

Electronic Governor Control

The governor controls engine rpm within a safe and stable operating range.

The low idle governor prevents engine rpm from dropping below a stable speed to prevent stalling when various loads are demanded on the engine.

The high idle governor prevents engine rpm from going above a safe speed that would cause engine damage.

Event Logging System

The event logging system records engine operation above maximum rpm (overspeed), low coolant level, high coolant temperature, or low oil pressure. The readings for the odometer and hourmeter are stored in the ECM memory at the time of an event and can be retrieved using the EST.

Fast Idle Advance

Fast idle advance increases engine idle speed up to 875 rpm for faster warm up to operating temperature. This occurs when the Engine Control Module (ECM) monitors ECT1 sensor input and adjusts the fuel injector operation accordingly.

Low idle speed is increased proportionally when the engine coolant temperature is below 158°F (70°C) at 700 rpm to below 14°F (-10°C) at 875 rpm maximum.

J1939 Datalink

Vehicles are equipped with the SAE J1939 connector for communication between the Engine Control Module (ECM), Aftertreatment Control Module (ACM), Doser Control Unit (DCU), transmission controller, ABS controller, Body Controller (BC) and Electronic Service Tool (EST).

The SAE J1939 datalink supports:

- Transmission of engine parameter data
- Transmission and clearing of Diagnostic Trouble Codes (DTCs)
- Diagnostics and troubleshooting
- Programming performance parameter values
- Programming engine and vehicle features
- Programming calibrations and strategies in the ECM, ACM, DCU, transmission controller, ABS controller

Service Diagnostics

Model year 2010 forward vehicles utilize DTCs identified using SPN and FMI identifiers only. These two identifiers are displayed in the Electronic Service Tool (EST) with ServiceMaxx™ software in the DTC window.

The EST provides diagnostic information using the SAE J1939 datalink. The recommended EST is the EZ-Tech® with ServiceMaxx™ diagnostic software provided by Navistar®.

Faults from sensors, actuators, electronic components, and engine systems are detected by the ECM , ACM, DCU, transmission controller, ABS controller and sent to the EST as codes. Effective engine diagnostics require and rely on codes.

Identification is accomplished using two fault code identifiers.

- **SPN:** The Suspect Parameter Number (SPN) identifies the individual component causing the DTC.
- **FMI:** The Failure Mode Indicator (FMI) identifies the fault or condition effecting the individual component.

Optional Electronic Control Features

Cruise Control

The Engine Control Module (ECM) controls the cruise control feature. The cruise control system functions similarly for all electronic engines. Maximum and minimum allowable cruise control speeds will vary based on model. To operate cruise control, see appropriate truck model *Operator's Manual*.

Engine Brake

The engine brake is a compression release brake system used to aid in the deceleration rate of the vehicle. This option is built into the high-pressure oil manifold under the engine valve cover. This option cannot be combined with the exhaust brake.

Engine Warning Protection System (EWPS)

The EWPS safeguards the engine from undesirable operating conditions to prevent engine damage and to prolong engine life. The ECM will illuminate the red ENGINE lamp and sound the warning buzzer when the ECM detects:

- High coolant temperature
- Low oil pressure
- Low coolant level (3-way system only)

When the protection feature is enabled and a critical engine condition occurs, the on-board electronics will shut the engine down (3-way protection). An event logging feature will record the event in engine hours and odometer readings. After the engine has shut down and the critical condition remains, the engine can be started for a 30-second run time.

Idle Shutdown Timer (IST)



GOVERNMENT REGULATION: State and local regulations may limit engine idle time. The vehicle owner or operator is responsible for compliance with those regulations.

The IST allows the ECM to shut down the engine during extended engine idle times.

Thirty seconds before IST-defined engine shutdown, a vehicle instrument panel indicator activates. There are two types of indicators:

- Amber flashing idle shutdown indicator for multiplex electrical systems
- Red flashing indicator with audible alarm for non-multiplex electrical systems

This continues until the engine shuts down or the low idle shutdown timer is reset.

IST for California ESS Compliant Engines

All Navistar ® engines certified for sale in the state of California will conform to mandatory California Air Resources Board (CARB) Engine Shutdown System (ESS) regulations.

Engine idle duration is limited for California ESS-compliant engines as follows:

- When vehicle parking brake is set, the idle shutdown time is limited to the CARB requirement of 5 minutes.

- When vehicle parking brake is released, the idle shutdown time is limited to the CARB requirement of 15 minutes.

The duration of CARB-mandated values can be reduced by programming the customer IST programmable parameter to a value lower than 15 minutes.

Engine Idle Shutdown Timer (IST for Federal – Optional)

Idle time can be programmed from 5 to 120 minutes. While the EST is installed, the IST function will be active with the programmed shutdown time in effect. Parking brake transitions reset the idle timer. If the IST is enabled, the Cold Ambient Protection (CAP) will not function.

Automatic Engine Speed Control (AESC)

Automatic Engine Speed Control (AESC) provides a method for an operator to set and maintain a constant engine speed without using the accelerator pedal. It is commonly used for powering auxiliary devices such as a Power Take-Off (PTO).

Customer-programmable parameters within the ECM provide in-cab engine speed control related options that can be adjusted to suit the customer's needs. Choosing whether the operator is allowed to increase the engine speed using the accelerator pedal without disengaging the PTO is an example.

Service Interval

The service interval feature is designed to provide a visual reminder to the operator that the oil change interval has expired and routine maintenance procedures should be performed.

The term "interval" in this case is used to describe the distance, time, or fuel used between the last maintenance performed on the vehicle and the next maintenance, which is due.

It is essential that operators are trained to know the maintenance schedules and instructions regarding the operation and reset functionality of the service interval for the feature to be effective.

The change engine oil interval message can be programmed with the EST for mileage, hours, or amount of fuel used. The change oil message timer can be reset using the CRUISE ON and RESUME/ACCEL switches or the Electronic Service Tool (EST).

Traction Control

Traction control is a system that identifies when one or more wheel is going faster than one of the other wheels during acceleration.

When a traction control condition occurs, a datalink message is sent to the ECM to limit fuel for the purpose of reducing engine torque.

Vehicles must have a transmission and an Antilock Braking System (ABS) that supports traction control.

Road Speed Limiter

Road Speed Limiting (RSL) is a feature designed to regulate the maximum vehicle speed as controlled by the accelerator pedal.

Customer-programmable parameters within the ECM provide vehicle speed governor related options that can be adjusted to suit the customer's needs. A parameter is used to set the maximum accelerator controlled vehicle speed.

Additional programming flexibility is included to allow a trade-off to be made between performance and fuel economy.

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Abbreviations and Acronyms

Abbreviations and Acronyms

A or amp – Ampere
AAT – Ambient Air Temperature
ABDC – After Bottom Dead Center
ABS – Antilock Brake System
AC – Alternating Current
A/C – Air Conditioner
ACC – Air Conditioner Control
ACCEL – Accelerator
ACD – Air Conditioner Demand
ACT PWR GND – Actuator Power Ground
ACV – Air Control Valve
AESC – Automatic Engine Speed Control
A/F – Air to Fuel ratio
AFD – Aftertreatment Fuel Drain
AFI – Aftertreatment Fuel Injector
AFP – Aftertreatment Fuel Pressure
AFS – Aftertreatment Fuel Supply
AFT – Aftertreatment
AFTFD – Aftertreatment Fuel Doser
AFT: DI – AFT Doser Injector
AFTFD-H – Aftertreatment Fuel Doser High
AFTFD-L – Aftertreatment Fuel Doser Low
AFTFIT – Aftertreatment Fuel Intake Temperature
AFT: FEC – Aftertreatment Fuel Enable Control
AFTFIS – Aftertreatment Fuel Intake Sensor
AFTFP – Aftertreatment Fuel Pressure
AFT: FP1 – Aftertreatment Fuel Pressure 1
AFT: FP2 – Aftertreatment Fuel Pressure 2
AFT: FPC – Aftertreatment Fuel Pressure Control
AFTFS-H – Aftertreatment Fuel Shutoff High
AFTFS-L – Aftertreatment Fuel Shutoff Low
AFTFSV – Aftertreatment Fuel Shutoff Valve
AFT: FT – Aftertreatment Fuel Temperature
AIT – Air Intake Temperature
Amb – Ambient
amp or A – Ampere
AMS – Air Management System
API – American Petroleum Institute
APP – Accelerator Pedal Position
APP1 – Accelerator Pedal Position 1
APP2 – Accelerator Pedal Position 2
APS – Accelerator Position Sensor
APS/IVS – Accelerator Position Sensor / Idle Validation Switch
ASTM – American Society for Testing and Materials
ATA – American Trucking Association
ATA-H – American Trucking Association Link High
ATA-L – American Trucking Association Link Low
ATDC – After Top Dead Center

AWG – American Wire Gauge
AWL – Amber Warning Lamp

B+ or VBAT – Battery Voltage
BAP or BARO – Barometric Absolute Pressure
BARO or BAP – Barometric Absolute Pressure
BBDC – Before Bottom Dead Center
BC – Body Controller
BCP – Brake Control Pressure
BCS – Boost Control Solenoid
BDC – Bottom Dead Center
bhp – Brake Horsepower
BNO – Brake Normally Open
BOO – Brake On / Off
BPP – Brake Pedal Position
BPS – Brake Pressure Switch
BSV – Brake Shut-off Valve
BTDC – Before Top Dead Center
BTU – British Thermal Unit

C – Celsius
CAC – Charge Air Cooler
CACOT – Charge Air Cooler Outlet Temperature
CAN – Controller Area Network
CAN-H – Controller Area Network High
CAN-L – Controller Area Network Low
CAP – Cold Ambient Protection
CARB – California Air Resources Board
cc – Cubic centimeter
CCA – Cold Cranking Ampere
CCV – Coolant Control Valve
CCOSS – Crankcase Oil Separator Speed
CCPS – Crankcase Pressure Sensor
CCS – Cruise Control Switches
CDR – Crankcase Depression Regulator
cfm – Cubic feet per minute
cfs – Cubic feet per second
CFV – Coolant Flow Valve
CID – Cubic Inch Displacement
CKP – Crankshaft Position
CKP-H – Crankshaft Position High
CKP-L – Crankshaft Position Low
CKPO – Crankshaft Position Out
cm – Centimeter
CMP – Camshaft Position
CMP-H – Camshaft Position High
CMP-L – Camshaft Position Low
CMPO – Camshaft Position Out
CMV – Coolant Mixer Valve
CO – Carbon Monoxide
CO_2 – Carbon Dioxide

COO – Cruise On / Off switch
CPU – Central Processing Unit
CSFI – Cold Start Fuel Igniter
CSFS – Cold Start Fuel Solenoid
CSR – Cold Start Relay
CSS – Cold Start Solenoid
CTC – Coolant Temperature Compensation
Cyl – Cylinder

DB – Decibel
DC – Direct Current
DCA – Diesel Coolant Additive
DCU – Doser Control Unit
DDI – Digital Direct Fuel Injection
DDS – Driveline Disengagement Switch
DEF – Diesel Exhaust Fluid
DEF: AP – Diesel Exhaust Fluid Absolute Pressure
DEF: DU – Diesel Exhaust Fluid Dosing Unit
DEF: L1HC – Diesel Exhaust Fluid Line 1 Heater Control (Supply)
DEF: L2HC – Diesel Exhaust Fluid Line 2 Heater Control (Return)
DEF: L3HC – Diesel Exhaust Fluid Line 3 Heater Control (Pressure)
DEF: RCV – Diesel Exhaust Fluid Reverting Control Valve
DEF: SMH – Diesel Exhaust Fluid Supply Module Heater
DEF: SP – Diesel Exhaust Fluid Supply Pump
DEF: THC – Diesel Exhaust Fluid Tank Heater Control
DEF: TL – Diesel Exhaust Fluid Tank Level
DEF: TT – Diesel Exhaust Fluid Tank Temperature
DLC – Data Link Connector
DME – Dimethyl Ether
DMM – Digital Multimeter
DOC – Diesel Oxidation Catalyst
DOCIT – Diesel Oxidation Catalyst Intake Temperature
DOCOT – Diesel Oxidation Catalyst Outlet Temperature
DPF – Diesel Particulate Filter
DPFDP – Diesel Particulate Filter Differential Pressure
DPFIT – Diesel Particulate Filter Intake Temperature
DPFOP – DPF Outlet Pressure
DPFOT – Diesel Particulate Filter Outlet Temperature
DSI – Down Stream Injection
DT – Diesel Turbocharged
DTC – Diagnostic Trouble Code
DTCs – Diagnostic Trouble Codes
DTRM – Diesel Thermo Recirculation Module

EBC – Exhaust Brake Controller
EBP – Exhaust Back Pressure
EBPC – Exhaust Back Pressure Control
EBPD – Exhaust Back Pressure Desired
EBPV – Exhaust Back Pressure Valve
ECB – Engine Compression Brake
ECB1 – Engine Compression Brake 1

ECB2 – Engine Compression Brake 2
ECB3 – Engine Compression Brake 3
ECBP – Engine Compression Brake Pressure
ECI – Engine Crank Inhibit
ECL – Engine Coolant Level
ECM – Engine Control Module
ECM GND – Engine Control Module Ground
ECM PWR – Engine Control Module Power
ECS – Engine Coolant System
ECSR – Engine Controlled Shutdown Request
ECT – Engine Coolant Temperature
ECT1 – Engine Coolant Temperature 1
ECT2 – Engine Coolant Temperature 2
EFAN – Engine Fan
EFANS – Engine Fan Speed
EFC – Engine Fan Control
EFP – Engine Fuel Pressure
EFRC – Engine Family Rating Code
EFS – Engine Fan Speed
EFP – Electric Fuel Pump
EFT – Engine Fuel Temperature
EG – Ethylene Glycol
EGC – Electronic Gauge Cluster
EGBP – Exhaust Gas Back Pressure
EGDP – Exhaust Gas Differential Pressure
EGR – Exhaust Gas Recirculation
EGRC – Exhaust Gas Recirculation Control
EGRH – Exhaust Gas Recirculation High control
EGRL – Exhaust Gas Recirculation Low control
EGROT – Exhaust Gas Recirculation Outlet Temperature
EGRP – Exhaust Gas Recirculation Position
EGRT – Exhaust Gas Recirculation Temperature
EGRVC – Exhaust Gas Recirculation Valve Control
EGT – Exhaust Gas Temperature
EGT1 – Exhaust Gas Temperature 1
EGT2 – Exhaust Gas Temperature 2
EGT3 – Exhaust Gas Temperature 3
EIM – Engine Interface Module
ELS – Exhaust Lambda Sensor
EMI – Electromagnetic Interference
EMP – Exhaust Manifold Pressure
EMT – Exhaust Manifold Temperature
EOL – Engine Oil Level
EOP – Engine Oil Pressure
EOT – Engine Oil Temperature
EPA – Environmental Protection Agency
EPR – Engine Pressure Regulator
ESC – Electronic System Controller
ESN – Engine Serial Number
ESS – Engine Shutdown System
EST – Electronic Service Tool

ETC – Engine Throttle Control
ETC-H – Engine Throttle Control High
ETC-L – Engine Throttle Control Low
ETP – Engine Throttle Valve Position
ETV – Engine Throttle Valve
ETV-H – Engine Throttle Valve High
ETV-L – Engine Throttle Valve Low
EVB – Exhaust Valve Brake
EWPS – Engine Warning Protection System

F – Fahrenheit
FCV – Fuel Coolant Valve
FDP – Fuel Delivery Pressure
FEL – Family Emissions Limit
fhp – Friction horsepower
FMI – Failure Mode Indicator
FPC – Fuel Pump Control
FPCV – Fuel Pressure Control Valve
fpm – Feet per minute
FPM – Fuel Pump Monitor
fps – Feet per second
FRP – Fuel Rail Pressure
ft – Feet
FVCV – Fuel Volume Control Valve

GND – Ground (electrical)
gal – Gallon
gal/h – U.S. Gallons per hour
gal/min – U.S. Gallons per minute
GCW – Gross Combined Weight
GCWR – Gross Combined Weight Rating
GPC – Glow Plug Control
GPD – Glow Plug Diagnostic
GPR – Glow Plug Relay
GVW – Gross Vehicle Weight

H_2O – Water
HC – Hydrocarbons
HCI – Hydrocarbon Injection
HEST – High Exhaust System Temperature
HFCM – Horizontal Fuel Conditioning Module
Hg – Mercury
hp – Horsepower
HPCAC – High-Pressure Charge Air Cooler
HPCR – High-Pressure Common Rail
HPFP – High-Pressure Fuel Pump
hr – Hour
HS – Humidity Sensor
Hyd – Hydraulic

IAH – Intake Air Heater

IAHC – Intake Air Heater Control
IAHD – Intake Air Heater Diagnostic
IAHR – Intake Air Heater Relay
IAT – Intake Air Temperature
IC – Integrated Circuit
ICP – Injection Control Pressure
ICPR – Injection Control Pressure Regulator
ICG1 – Injector Control Group 1
ICG2 – Injector Control Group 2
ID – Inside Diameter
IDM – Injector Driver Module
IGN – Ignition
ILO – Injector Leak Off
IMP – Intake Manifold Pressure
IMT – Intake Manifold Temperature
in – Inch
inHg – Inch of mercury
inH_2O – Inch of water
INJ#1-6 – Injector 1-6
IPR – Injection Pressure Regulator
IPR PWR – Injection Pressure Regulator Power
ISC – Interstage Cooler
ISIS® – International® Service Information Solutions
IST – Idle Shutdown Timer
ITP – Internal Transfer Pump
ITV – Intake Throttle Valve
ITV-H – Intake Throttle Valve High control
ITV-L – Intake Throttle Valve Low control
ITVP – Intake Throttle Valve Position
IVS – Idle Validation Switch

J1939-H – J1939 Data Link High
J1939-L – J1939 Data Link Low
JCT – Junction (electrical)

KAPWR – Keep Alive Power
kg – Kilogram
km – Kilometer
km/h – Kilometers per hour
km/l – Kilometers per liter
KOEO – Key-On Engine-Off
KOER – Key-On Engine-Running
kPa – Kilopascal

L – Liter
L/h – Liters per hour
L/m – Liters per minute
L/s – Liters per second
lb – Pound
lb – Pounds of force
lb/s – Pounds per second

lb ft – Pounds of force per foot
lb in – Pounds of force per inch
lbm – Pounds of mass
LPCAC – Low-pressure Charge Air Cooler
LSD – Low Sulfur Diesel

m – Meter
m/s – Meters per second
MAF – Mass Air Flow
MAF GND – Mass Air Flow Ground
MAG – Magnetic
MAP – Manifold Absolute Pressure
MAP / IAT – Manifold Absolute Pressure / Intake Air Temperature
MAT – Manifold Air Temperature
mep – Mean effective pressure
mi – Mile
MIL – Malfunction Indicator Lamp
mm – Millimeter
mpg – Miles per gallon
mph – Miles per hour
MPR – Main Power Relay
MSDS – Material Safety Data Sheet
MSG – Micro Strain Gauge
MSM – Multiplex System Module
MY – Model Year

NC – Normally Closed (electrical)
NETS – Navistar Electronics Technical Support
NH3 – Aftertreatment Ammonia
N·m – Newton meter
NO – Normally Open (electrical)
NO_x – Nitrogen Oxides
NO_x In – Nitrogen Oxide Intake Concentration
NO_x Out – Nitrogen Oxide Outlet Concentration

O_2S – Oxygen Sensor
O_2SH – Oxygen Sensor Heater
OAT – Organic Acid Technology
OCC – Output Circuit Check
OCP – Overcrank Protection
OD – Outside Diameter
OL – Over Limit
ORH – Out-of-Range High
ORL – Out-of-Range Low
OSHA – Occupational Safety and Health Administration
OWL – Oil / Water Lamp

PID – Parameter Identifier
P/N – Part Number
PDOC – Pre-Diesel Oxidation Catalyst
PDM – Power Distribution Module

ppm – Parts per million
PROM – Programmable Read Only Memory
psi – Pounds per square inch
psia – Pounds per square inch absolute
psig – Pounds per square inch gauge
pt – Pint
PTO – Power Takeoff
PWM – Pulse Width Modulate
PWR – Power (voltage)

qt – Quart

RAM – Random Access Memory
RAPP – Remote Accelerator Pedal Position
RAS – Resume / Accelerate Switch (speed control)
REPTO – Rear Engine Power Takeoff
RFI – Radio Frequency Interference
rev – Revolution
rpm – Revolutions per minute
RPRE – Remote Preset
RSE – Radiator Shutter Enable
RSL – Road Speed Limiter
RVAR – Remote Variable

SAE – Society of Automotive Engineers
SCA – Supplemental Cooling Additive
SCCS – Speed Control Command Switches
SCR – Selective Catalytic Reduction
SCROT – Selective Catalytic Reduction Outlet Temperature
SCS – Speed Control Switch
SHD – Shield (electrical)
SID – Subsystem Identifier
SIG GND – Signal Ground
SIG GNDB – Signal Ground Body
SIG GNDC – Signal Ground Chassis
SIG GNDE – Signal Ground Engine
S/N – Serial Number
SPEEDO – Speedometer
SPN – Suspect Parameter Number
SW – Switch (electrical)
SWBAT – Switch Battery
SYNC – Synchronization

TACH – Tachometer output signal
TBD – To Be Determined
TC2CIS – Turbocharger 2 Compressor Intake Sensor
TC2CIT – Turbocharger 2 Compressor Intake Temperature
TC1TOP – Turbocharger 1 Turbine Outlet Pressure
TC2TOP – Turbocharger 2 Turbine Outlet Pressure
TC2WG – Turbocharger 2 Wastegate Position
TC2WC – Turbocharger 2 Wastegate Control

TCAPE – Truck Computer Analysis of Performance and Economy
TCM – Transmission Control Module
TCWC – Turbocharger Wastegate Control
TDC – Top Dead Center
TDE – Transmission Driving Engaged
TOP – Transmission Oil Pressure
TOSS – Transmission Output Shaft Speed
TOT – Transmission Oil Temperature
TTS – Transmission Tailshaft Speed

ULSD – Ultra-Low Sulfur Diesel
UVC – Under Valve Cover

V – Volt
VBAT or B+ – Battery Voltage
VC – Volume Control
VEPS – Vehicle Electronics Programming System
VGT – Variable Geometry Turbo
VIGN – Ignition Voltage
VIN – Vehicle Identification Number
VOP – Valve Opening Pressure
VRE – Vehicle Retarder Enable
VREF – Reference Voltage
VREF1 – Reference Voltage Engine
VREF2 – Reference Voltage Chassis
VREF3 – Reference Voltage Chassis
VREF4 – Reference Voltage Aftertreatment
VSO – Vehicle Speed Output
VSO or VSS_CAL – Vehicle Speed Output
VSS – Vehicle Speed Sensor
VSS_CAL or VSO – Vehicle Speed Output
VSS-H – Vehicle Speed Sensor High
VSS-L – Vehicle Speed Sensor Low

WTSL – Wait to Start Lamp
WEL – Warn Engine Lamp
WIF – Water In Fuel
WIFL – Water In Fuel Lamp
WTEC – World Transmission Electronically Controlled automatic transmissions (Allison)

XCS – Transfercase
XMSN – Transmission

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Terminology

Terms

Accelerator Pedal Position (APP) sensor – A potentiometer sensor that indicates the position of the throttle pedal.

Accessory work – The work per cycle required to drive engine accessories (normally, only those essential to engine operation).

Actuator – A device that performs work in response to an input signal.

Actuator Control – The Engine Control Module (ECM) controls the actuators by applying a low-level signal (low-side driver) or a high-level signal (high side driver). When switched on, both drivers complete a ground or power circuit to an actuator.

Aeration – The entrainment of air or combustion gas in coolant, lubricant, or fuel.

Aftercooler – See Charge Air Cooler.

Aftertreatment (AFT) system – A part of the exhaust system that processes engine exhaust to meet emission requirements and traps particulate matter (soot) to prevent it from leaving the tailpipe.

Aftertreatment Fuel Doser (AFTFD) – A part of the Downstream Injection (DSI) unit that sends pressurized fuel to the Aftertreatment Fuel Injector (AFI) to inject fuel into the exhaust pipe.

Aftertreatment Fuel Intake Sensor (AFTFIS) – A sensor that monitors fuel temperature in the DSI system and provides constant feedback to the ECM.

Aftertreatment Fuel Pressure 2 Sensor (AFTP2) – A sensor that monitors fuel pressure in the DSI system and provides constant feedback to the ECM.

Aftertreatment Fuel Shutoff Valve (AFTFSV) – A valve used to prevent fuel flow to the AFI, and prevents all uncontrolled fuel delivery for the Aftertreatment system during an AFTFD valve malfunction.

Air Control Valve (ACV) – Contains the LP turbocharger wastegate control port, HP turbocharger wastegate control port, the Exhaust Back Pressure Valve (EBPV) control port, and the Turbocharger 1 Turbine Outlet Pressure (TC1TOP) port. Although these components are integral to the ACV, each circuit is controlled by the ECM. The ACV controls compressed air for each control valve.

Air Intake Temperature (AIT) sensor – A thermistor sensor that monitors intake air temperature.

Ambient Air Temperature (AAT) sensor – A sensor that sends an ambient air temperature signal to the ECM.

Ambient temperature – The environmental air temperature in which a unit is operating. In general, the temperature is measured in the shade (no solar radiation) and represents the air temperature for other engine cooling performance measurement purposes. Air entering the radiator may or may not be the same ambient due to possible heating from other sources or recirculation. (SAE J1004 SEP81)

American Trucking Association (ATA) Datalink – A serial datalink specified by the American Trucking Association and the SAE.

Ampere (amp) – The standard unit for measuring the strength of an electrical current. The flow rate of a charge in a conductor or conducting medium of one coulomb per second. (SAE J1213 NOV82)

Analog – A continuously variable voltage.

Analog to digital converter (A/D) – A device in the ECM that converts an analog signal to a digital signal.

Automatic Engine Speed Control (AESC) – Feature providing a method for an operator to set and maintain a constant engine speed without using the accelerator pedal. Commonly used for powering auxiliary devices such as a Power Take-Off (PTO).

Barometric Absolute Pressure (BAP) sensor – A sensor built into the ECM that provides barometric pressure information to the ECM.

Boost pressure – 1. The pressure of the charge air leaving the turbocharger.

2. Intake manifold pressure that is greater than atmospheric pressure. Obtained by turbocharging.

Bottom Dead Center (BDC) – The lowest position of the piston during the stroke.

Brake Horsepower (bhp) – The power output from an engine, not the indicated horsepower. The power output of an engine, sometimes-called flywheel horsepower, is less than the indicated horsepower by the amount of friction horsepower consumed in the engine.

Brake Horsepower (bhp) net – Net brake horsepower is measured with all engine components. The power of an engine when configured as a fully equipped engine. (SAE J1349 JUN90)

Brake On/Off (BOO) switch – A switch located on the brake pedal lever, that provides a brake pedal position signal to the ECM.

Brake Pressure Switch (BPS) – A switch located in the brake pressure line that provides a brake pedal position signal to the ECM.

Calibration – ECM programming strategy to solve engine performance equations and make decisions. Calibration values are stored in ROM and put into the processor during programming to allow the engine to operate within certain parameters.

Camshaft Position (CMP) sensor – A magnetic pickup sensor that provides the ECM with a camshaft speed and position signal.

Carbon Monoxide (CO) – A colorless, odorless, highly poisonous gas that is formed by the incomplete combustion of carbon burning diesel engine. It is present in the exhaust gases of diesel engines.

Catalyst – A substance that produces a chemical reaction without undergoing a chemical change itself.

Catalytic converter – An antipollution device in the exhaust system that contains a catalyst for chemically converting some pollutants in the exhaust gases (carbon monoxide, unburned hydrocarbons, and oxides of nitrogen) into harmless compounds.

Cavitation – A dynamic condition in a fluid system that forms gas-filled bubbles (cavities) in the fluid.

Cetane number – 1. The auto-ignition quality of diesel fuel.

2. A rating applied to diesel fuel similar to octane rating for gasoline.

3. A measure of how readily diesel fuel starts to burn (self-ignites) at high compression temperature.

Diesel fuel with a high cetane number self-ignites shortly after injection into the combustion chamber. Therefore, it has a short ignition delay time. Diesel fuel with a low cetane number resists self-ignition. Therefore, it has a longer ignition delay time.

Charge air – Dense, pressurized, heated air discharged from the turbocharger.

Charge Air Cooler (CAC) – A heat exchanger mounted in the charge air path between the turbocharger and engine intake manifold. The charge air cooler reduces the charge air temperature by transferring heat from the charge air to a cooling medium (usually air).

Charge Air Cooler Outlet Temperature (CACOT) sensor – A thermistor sensor that monitors the temperature of charge air entering the intake air duct.

Closed crankcase – A crankcase ventilation that recycles crankcase gases through a breather, then back to the clean air intake.

Closed loop operation – A system that uses sensors to provide feedback to the ECM. The ECM uses the sensor input to continuously monitor variables and adjust actuators to match engine requirements.

Cloud point – The point when wax crystals occur in fuel, making fuel cloudy or hazy. Usually below -12°C (10°F).

Cold cranking ampere rating (battery rating) – The sustained constant current (in amperes) needed to produce a minimum terminal voltage under a load of 7.2 volts per battery after 30 seconds.

Cold Start Fuel Igniter (CSFI) – The CSFI heats the intake air by vaporizing and igniting fuel in the air intake duct.

Cold Start Fuel Solenoid (CSFS) – As the engine is cranked, the ECM energizes the CSFS valve, introducing fuel into the CSFI, which ignites and warms the air being drawn into the engine.

Cold Start Relay (CSR) – The CSR provides voltage to the CSFI, and is controlled by the ECM.

Controller Area Network (CAN) – A J1939 high-speed communication link.

Coolant – A fluid used to transport heat from one point to another.

Coolant Flow Valve (CFV) – The CFV is ECM controlled and redirects coolant through the fuel cooler, based on Engine Fuel Temperature (EFT), when directed.

Coolant level switch – A switch sensor used to monitor coolant level.

Coolant Mixer Valve (CMV) – Controls coolant flow through the low-temperature radiator.

Continuous Monitor Test – An ECM function that continuously monitors the inputs and outputs to ensure that readings are within set limits.

Crankcase – The housing that encloses the crankshaft, connecting rods, and allied parts.

Crankcase breather – A vent for the crankcase to release excess interior air pressure.

Crankcase Oil Separator Speed (CCOSS) sensor – The CCOSS sensor sends the ECM information about the speed of the crankcase oil separator internal components.

Crankcase pressure – The force of air inside the crankcase against the crankcase housing.

Crankshaft Position (CKP) sensor – A magnetic pickup sensor that determines crankshaft position and speed.

Cruise Control Switches (CCS) – A set of switches used for cruise control, Power TakeOff (PTO), and remote hand throttle system.

Current – The flow of electrons passing through a conductor. Measured in amperes.

Cylinder Balance – An ECM control strategy to even-out the power contributions of each power cylinder.

Damper – A device that reduces the amplitude of torsional vibration. (SAE J1479 JAN85)

Deaeration – The removal or purging of gases (air or combustion gas) entrained in coolant or lubricating oil.

Deaeration tank – A separate tank in the coolant system used for one or more of the following functions:

- Deaeration
- Coolant reservoir (fluid expansion and afterboil)
- Coolant retention
- Filling
- Fluid level indication (visible)

Diagnostic Trouble Code (DTC) – Fault code identification utilized on pre-2010 vehicle model years. For vehicle model year 2010 or newer, fault codes are identified using the Suspect Parameter Number (SPN) and Failure Mode Indicator (FMI) identifiers.

Diamond Logic Builder (DLB) – The diagnostics software for chassis related components and systems.

Diesel Oxidation Catalyst (DOC) – A DOC is part of the diesel exhaust Aftertreatment system. DOCs are devices that use a chemical process to break down pollutants in the exhaust stream into less harmful components. More specifically, DOCs utilize rare metals such as palladium and platinum to reduce hydrocarbon based Soluble Organic Fraction (SOF) and carbon monoxide content of diesel exhaust by simple oxidation. The DOC can be used during an active regeneration to create higher exhaust temperatures, thereby reducing soot in the DPF.

Diesel Oxidation Catalyst Intake Temperature sensor (DOCIT) – A sensor that provides DOC intake temperature signal to the ECM.

Diesel Particulate Filter (DPF) – A diesel particulate filter, sometimes called a DPF, is a device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine.

Diesel Particulate Filter Differential Pressure (DPFDP) sensor – A sensor that measures pressure difference between the intake and outlet of the DPF and provides feedback to the ECM.

Diesel Particulate Filter Intake Temperature sensor (DPFIT) – A sensor that provides DOC intake temperature signal to the ECM.

Diesel Particulate Filter Outlet Temperature sensor (DPFOT) – A sensor that provides DOC outlet temperature signal to the ECM.

Digital Multimeter (DMM) – An electronic meter that uses a digital display to indicate a measured value. Preferred for use on microprocessor systems because it has a very high internal impedance and will not load down the circuit being measured.

Disable – A computer decision that deactivates a system and prevents operation of the system.

Displacement – The stroke of the piston multiplied by the area of the cylinder bore multiplied by the number of cylinders in the engine.

Down Stream Injection (DSI) – The DSI system injects fuel into the exhaust system to increase temperature of the exhaust gases, and is necessary for DPF regeneration.

Driver (high side) – A transistor within an electronic module that controls the power to an actuator circuit.

Driver (low side) – A transistor within an electronic module that controls the ground to an actuator circuit.

Dual Stage Turbocharger – An assembly of two turbochargers (low-pressure and high-pressure) in series to provide a wide range of charge air pressures efficiently.

Duty cycle – A control signal that has a controlled on/off time measurement from 0 to 100%. Normally used to control solenoids.

Engine Back Pressure Valve (EBPV) – The ECM commands the EBPV to control the Exhaust Brake.

Engine Compression Brake (ECB) valve – The ECB valve controls pressure entering the brake oil gallery from the high-pressure oil rail gallery. This activates the brake actuator pistons and opens the exhaust valves.

Engine Compression Brake 1 (ECB1) solenoid – The ECB1 solenoid controls pressure entering the brake oil gallery from the high-pressure oil rail gallery.

Engine Compression Brake 2 (ECB2) solenoid – The ECB2 solenoid controls pressure entering the brake oil gallery from the high-pressure oil rail gallery.

Engine Compression Brake Pressure (ECBP) sensor – A high-pressure sensor that provides a feedback signal to the ECM indicating brake control pressure.

Engine Control Module (ECM) – An electronic processor that monitors and controls the engine.

Engine Coolant Level (ECL) sensor – A switch sensor that monitors coolant level.

Engine Coolant Temperature 1 (ECT1) sensor – A thermistor sensor that detects engine coolant temperature.

Engine Coolant Temperature 2 (ECT2) sensor – A thermistor sensor that detects engine coolant temperature.

Electric Fuel Pump – Electric Fuel Pump

Engine Fuel Temperature (EFT) sensor – A thermistor sensor that measures fuel temperature.

Engine lamp – An instrument panel lamp that comes on when DTCs are set. DTCs can be read as flash codes (red and amber instrument panel lamps).

Engine OFF tests – Tests that are done with the ignition switch ON and the engine OFF.

Engine Oil Pressure (EOP) sensor – A variable capacitance sensor that measures oil pressure.

Engine Oil Temperature (EOT) sensor – A thermistor sensor that measures oil temperature.

Engine rating – Engine rating includes **Rated hp** and **Rated rpm**.

Engine RUNNING tests – Tests done with the engine running.

Engine Throttle Valve (ETV) and Engine Throttle Position Sensor – The ETV valve is used to control airflow during a regeneration process of the aftertreatment system. The ETV valve is also used to ensure a smooth engine shut down by restricting airflow to the engine at shut down.

Engine Warning Protection System (EWPS) – Safeguards the engine from undesirable operating conditions to prevent engine damage and to prolong engine life.

Exhaust Back Pressure (EBP) – The pressure present in the exhaust system during the exhaust period.

Exhaust Back Pressure Valve (EBPV) – A valve that regulates the amount of air pressure applied to the EBPV pneumatic actuator.

Exhaust brake – A brake device using engine exhaust back pressure as a retarding medium.

Exhaust Gas Recirculation (EGR) – A system used to recirculate a portion of the exhaust gases into the power cylinder in order to reduce oxides of nitrogen.

Exhaust Gas Recirculation (EGR) Cooler – A cooler that allows heat to dissipate from the exhaust gasses before they enter the intake manifold.

Exhaust Gas Recirculation Temperature (EGRT) sensor – A thermistor sensor that detects the exhaust gas temperature entering the EGR cooler.

Exhaust Gas Recirculation (EGR) valve – The EGRV controls the flow of exhaust gases to the intake manifold. The EGRV is integrated with an EGR Position (EGRP) sensor.

Exhaust Gas Temperature (EGT) – The temperature of exhaust gases.

Exhaust manifold – Exhaust gases flow through the exhaust manifold to the turbocharger exhaust intake and are directed to the EGR cooler.

Exhaust Manifold Pressure (EMP) sensor – A variable capacitance sensor used to indicate air pressure in the exhaust manifold.

Exhaust Manifold Temperature (EMT) sensor – A thermistor style sensor used to indicate air temperature in the exhaust manifold.

Failure Mode Indicator (FMI) – Identifies the fault or condition effecting the individual component.

Fault detection/management – An alternate control strategy that reduces adverse effects that can be caused by a system failure. If a sensor fails, the ECM substitutes a good sensor signal or assumed sensor value in its place. A lit amber instrument panel lamp signals that the vehicle needs service.

Filter restriction – A blockage, usually from contaminants, that prevents the flow of fluid through a filter.

Flash code – See **Diagnostic Trouble Code (DTC)**.

Fuel Cooler Control Valve – A valve used to redirect coolant through the fuel cooler.

Fuel Delivery Pressure (FDP) sensor – A variable capacitance sensor that monitors fuel pressure coming from the fuel tank and sends a signal to the ECM.

Fuel intake restriction – A blockage, usually from contaminants, that prevents the flow of fluid through the fuel intake line.

Fuel pressure – The force fuel exerts on the fuel system as it is pumped through the fuel system.

Fuel Pressure Control Valve (FPCV) – The FPCV controls the fuel pressure to the fuel rails and is controlled by the ECM. FPCV control depends on fuel pressure and fuel temperature.

Fuel Rail Pressure (FRP) – The amount of pressure in the fuel rail.

Fuel Rail Pressure (FRP) sensor – A variable capacitance sensor that monitors fuel pressure in the fuel rail and sends a signal to the ECM.

Fuel strainer – A pre-filter in the fuel system that keeps larger contaminants from entering the fuel system.

Fuel Volume Control Valve (FVCV) – The FVCV regulates the volume of flow sent to the HPFP. The FVCV allows a sufficient quantity of fuel to be delivered to the HPFP depending on engine load, speed, injector quantity, fuel temperature, and number of injections per cycle.

Fully equipped engine – A fully equipped engine is an engine equipped with only those accessories necessary to perform its intended service. A fully equipped engine does not include components that are used to power auxiliary systems. If these components are integral with the engine or, for any reason are included on the test engine, the power absorbed may be determined and added to the net brake power. (SAE J1995 JUN90)

Fusible link (fuse link) – A fusible link is a special section of low tension cable designed to open the circuit when subjected to an extreme current overload. (SAE J1156 APR86)

Gradeability – The maximum percent grade, which the vehicle can transverse for a specified time at a specified speed. The gradeability limit is the grade upon which the vehicle can just move forward. (SAE J227a)

Gross Combined Weight Rating (GCWR) – Maximum combined weight of towing vehicle (including passengers and cargo) and the trailer. The GCWR indicates the maximum loaded weight that the vehicle is allowed to tow.

Gross brake horsepower – The power of a complete basic engine, with air cleaner, without fan, and alternator, and air compressor not charging.

H-Bridge Circuit – An H-Bridge (bipolar) circuit operates like putting a power source on one side of a motor and connecting the other side of the motor to a ground. This turns the motor. By shifting the leads on the motor, it will turn in the opposite direction.

Hall effect – The development of a transverse electric potential gradient in a current-carrying conductor or semiconductor when a magnetic field is applied.

Hall effect sensor – Transducer that varies its output voltage in response to changes in a magnetic field. Commonly used to time the speed of wheels and shafts.

High-pressure Fuel Pump (HPFP) assembly – The HPFP is a volumetric pump that supplies fuel at high-pressure. The HPFP is mounted in the rear valley on the top of the engine and is driven by the camshaft.

High-pressure Piezo Common Rail (HPCR) – The HPFP pumps fuel through separate tubes to each fuel rail. Each fuel rail has four fuel tubes, one for each injector, that maintain constant pressure from the high-pressure pump to each injector.

High-speed digital inputs – Inputs to the ECM from a sensor that generates varying frequencies (engine speed and vehicle speed sensors).

Horsepower (hp) – Horsepower is the unit of work done in a given period of time, equal to 33,000 pounds multiplied by one foot per minute. 1hp = 33,000 lb x 1 ft /1 min.

Humidity Sensor (HS) – A sensor that measures the moisture content of filtered air entering the intake system.

Hydrocarbons – Organic compounds consisting of hydrogen and carbon (fuel and oil).

Hydrocarbon Injector – Injects fuel into the exhaust system to increase temperature of the exhaust gases.

Idle Shutdown Timer (IST) – An engine calibration that allows the ECM to shut down the engine during extended engine idle times.

Injection Control Pressure (ICP) sensor – Provides a feedback signal to the ECM indicating injection control pressure.

Injection Pressure Regulator (IPR) valve – A valve that is used to maintain desired injection control pressure.

Intake Air Heater (IAH) – The IAH is primarily used to assist in starting the engine during cold weather. In addition, it helps to reduce white smoke emissions by heating the incoming air.

Intake manifold – Engine component that evenly supplies air to each intake port in the cylinder head(s).

Intake Manifold Pressure (IMP) sensor – A variable capacitance sensor used to indicate air pressure in the intake manifold.

Intake Manifold Temperature (IMT) sensor – A thermistor sensor used to indicate air temperature in the intake manifold.

Internal Transfer Pump (ITP) – The ITP is part of the HPFP assembly and driven off the same shaft as the HPFP assembly. The ITP supplies fuel at a slightly higher pressure and flow to the HPFP though the FVCV. The ITP also provides fuel for cooling and lubrication of the HPFP. Fuel is rerouted as pump return flow through the HPFP cooling and lubrication valve. Pressure is maintained at the intake of the HPFP piston pump by an ITP regulator.

Interstage Cooler (ISC) – Uses cooled coolant to lower the charged air temperature that exits from the turbocharger low-pressure compressor and enters the turbocharger high-pressure compressor.

Low speed digital inputs – Switched sensor inputs that generate an on/off (high/low) signal to the ECM. The input to the ECM from the sensor could be from a high input source switch (usually 5 or 12 volts) or from a grounding switch that grounds the signal from a current limiting resistor in the ECM that creates a low signal (0 volts).

Low temperature radiator thermostat – Coolant flow to the low temperature radiator is regulated by the low temperature radiator thermostat.

Lubricity – Lubricity is the ability of a substance to reduce friction between solid surfaces in relative motion under loaded conditions.

Lug (engine) – A condition when the engine is run at an overly low RPM for the load being applied.

Malfunction Indicator Lamp (MIL) – An indicator lamp in the Electronic Instrument Cluster that will illuminate when a detected emissions fault occurs.

Manifold Absolute Pressure (MAP) – Boost pressure in the manifold that is a result of the turbocharger.

Manifold Absolute Pressure (MAP) sensor – A variable capacitance sensor that measures boost pressure.

Manometer – A double-leg liquid-column gauge, or a single inclined gauge, used to measure the difference between two fluid pressures. Typically, a manometer records in inches of water.

Mass Air Flow (MAF) – The intake airflow in an engine.

Mass Air Flow (MAF) sensor – The MAF sensor is used for closed loop control of the EGR valve and ITV. The ECM monitors the MAF signal so that the ECM can control the EGR and intake throttle systems.

Magnehelic Gauge – A gauge that measures pressure in inches of water.

Magnetic Pickup Sensor – A magnetic pickup sensor generates an alternating frequency that indicates speed. Magnetic pickups have a two-wire connection for signal and ground. This sensor has a permanent magnetic core surrounded by a wire coil. The signal frequency is generated by the rotation of the gear teeth that disturb the magnetic field.

Metering unit valve assembly – The Metering unit valve assembly provides a metered amount of fuel to the Aftertreatment Fuel Injector (AFI).

Microprocessor – An integrated circuit in a microcomputer that controls information flow.

Micro Strain Gauge (MSG) Sensor – A MSG sensor measures pressure. Pressure exerts force on a pressure vessel that stretches and compresses to change resistance of strain gauges bonded to the surface of the pressure vessel. Internal sensor electronics convert the changes in resistance to a ratiometric voltage output.

Nitrogen Oxides (NO_x) – Nitrogen oxides form by a reaction between nitrogen and oxygen at high temperatures and pressures in the combustion chamber.

Normally closed – Refers to a switch that remains closed when no control force is acting on it.

Normally open – Refers to a switch that remains open when no control force is acting on it.

Ohm (Ω) – The unit of electrical resistance. One ohm is the value of resistance through which a potential of one volt will maintain a current of one ampere. (SAE J1213 NOV82)

On demand test – A self-test the technician initiates using the EST that is run from a program in the software.

Output Circuit Check (OCC) – An on-demand test done during an Engine OFF self-test to check the continuity of selected actuators.

Output Shaft Speed (OSS) sensor – A sensor mounted to the rear of the transmission that supplies a vehicle speed signal to the ECM. The ECM uses this signal to control Power Takeoff (PTO), road speed limiting, and cruise control. Automatic transmissions use this signal for shift scheduling.

Oxides of Nitrogen (NOx) – Nitrogen oxides formed by a reaction between nitrogen and oxygen at high temperatures.

Oxygen Sensor (O2S) – A sensor that monitors oxygen levels in the exhaust.

pH – A measure of the acidity or alkalinity of a solution.

Particulate matter – Particulate matter includes mostly burned particles of fuel and engine oil.

Piezometer – An instrument for measuring fluid pressure.

Power – Power is a measure of the rate at which work (force x distance) is done during a specific time. Compare with Torque.

Power TakeOff (PTO) – Accessory output, usually from the transmission, used to power a hydraulic pump for a special auxiliary feature (garbage packing, lift equipment, etc).

Pulse Width Modulation (PWM) – Succession of digital electrical pulses, rather than an analog signal. Efficient method of providing power between fully on and fully off.

Radiator Shutter Enable (RSE) – A feature that uses various input signals to open or close radiator shutters by energizing or de-energizing a solenoid that controls an air or hydraulic cylinder.

Random Access Memory (RAM) – Computer memory that stores information. Information can be written to and read from RAM. Input information (current engine speed or temperature) can be stored in RAM to be compared to values stored in Read Only Memory (ROM). All memory in RAM is lost when the ignition switch is turned off.

Rated gross horsepower – Engine gross horsepower at rated speed as declared by the manufacturer. (SAE J1995 JUN90)

Rated horsepower – Maximum brake horsepower output of an engine as certified by the engine manufacturer. The power of an engine when configured as a basic engine. (SAE J1995 JUN90)

Rated net horsepower – Engine net horsepower at rated speed as declared by the manufacturer. (SAE J1349 JUN90)

Rated speed – The speed, as determined by the manufacturer, at which the engine is rated. (SAE J1995 JUN90)

Rated torque – Maximum torque produced by an engine as certified by the manufacturer.

Ratiometric Voltage – In a MSG sensor, pressure to be measured exerts force on a pressure vessel that stretches and compresses to change resistance of strain gauges bonded to the surface of the pressure vessel. Internal sensor electronics convert the changes in resistance to a ratiometric voltage output.

Reference voltage (V_{REF}) – A 5 volt reference supplied by the ECM to operate the engine sensors.

Regeneration – Oxidation of accumulated soot (carbon-based particulates) in the DPF. The soot is reduced to ash and stored in the PDF.

Remote Accelerator Pedal Position (RAPP) – A feature that allows the operator to set and maintain a constant engine speed from outside the vehicle cab. This feature may also be known as Remote Engine Speed Control (RESC). Control over engine speed is accomplished by using remote mounted switches to turn on the RESC and select the desired engine speed.

Remote Engine Speed Control (RESC) – See Remote Accelerator Pedal Position.

Reserve capacity – Time in minutes that a fully charged battery can be discharged to 10.5 volts at 25 amperes.

Return Fuel System – The return fuel system moves unused fuel from the fuel injectors to the fuel cooler. Excess fuel out of the FVCV and the FPCV mix with fuel from the fuel injectors on the way to the fuel cooler.

Road Speed Limiter (RSL) – Feature designed to regulate the maximum vehicle speed as controlled by the accelerator pedal.

ServiceMaxx™ software – Diagnostics software for engine related components and systems.

Signal Conditioner – The signal conditioner in the internal microprocessor converts analog signals to digital signals, squares up sine wave signals, or amplifies low-intensity signals to a level that the ECM microprocessor can process.

Signal ground – The common ground wire to the ECM for the sensors.

Speed Control Command Switches (SCCS) – A set of switches used for cruise control, Power TakeOff (PTO), and remote hand throttle system.

Starter Motor Control (SMC) – An ECM function that prevents starter engagement while the engine is running (above a set calibrated rpm), when the automatic transmission is in gear, or when the manual transmission clutch pedal is not depressed.

Steady state condition – An engine operating at a constant speed and load and at stabilized temperatures and pressures. (SAE J215 JAN80)

Strategy – A plan or set of operating instructions that the microprocessor follows for a desired goal. Strategy is the computer program itself, including all equations and decision making logic. Strategy is always stored in ROM and cannot be changed during calibration.

Stroke – The movement of the piston from Top Dead Center (TDC) to BDC.

Substrate – Material that supports the wash coating or catalytic materials.

Suspect Parameter Number (SPN) – A 19-bit number used to identify the item for which diagnostics are being reported. The SPN is used for multiple purposes, some that are specific to diagnostics are as follows:

- Identify the least repairable subsystem that has failed.
- Identify subsystems or assemblies that may not have hard failures but may be exhibiting abnormal operating performance.
- Identify a particular event or condition that will be reported.
- Report a component and non-standard failure mode.

System restriction (air) – The static pressure differential that occurs at a given airflow from air entrance through air exit in a system. Usually measured in inches (millimeters) of water. (SAE J1004 SEP81)

Tachometer output signal – Engine speed signal for remote tachometers.

Thermistor – A semiconductor device. A sensing element that changes resistance as the temperature changes.

Thermistor Sensor – Changes electrical resistance with changes in temperature. Resistance in the thermistor decreases as temperature increases, and increases as temperature decreases. Thermistors work with a resistor that limits current to form a voltage signal matched with a temperature value.

Thrust load – A thrust load pushes or reacts through a bearing in a direction parallel to the shaft.

Top Dead Center (TDC) – The uppermost position of the piston during the stroke.

Torque – A force having a twisting or turning effect. For a single force, the cross product of a vector from some reference point to the point of application of the force within the force itself. Also known as moment of force or rotation moment. Torque is a measure of the ability of an engine to do work.

Traction Control – System that identifies when one or more wheel is going faster than one of the other wheels during acceleration.

Truck Computer Analysis of Performance and Economy (TCAPE) – A computer program that simulates the performance and fuel economy of trucks.

Turbocharger – A turbine driven compressor mounted on the exhaust manifold. The turbocharger increases the pressure, temperature and density of intake air to charge air.

Turbocharger 1 Turbine Outlet Pressure (TC1TOP) sensor – A variable capacitance sensor that monitors exhaust back-pressure.

Turbocharger 2 Compressor Intake (TC2CIS) sensor – The TC2CIS sensor includes a thermistor sensor that monitors the temperature of charge air entering the HP turbocharger. This sensor also monitors boost pressure for the LP turbocharger.

Turbocharger 2 Compressor Intake Temperature (TC2CIT) sensor – The TC2CIT sensor is a thermistor-based sensor that monitors the temperature of charge air entering the HP turbocharger.

Turbocharger Outlet Temperature (TCOT) sensor – A sensor that provides a turbocharger outlet temperature signal to the ECM.

Turbocharger Wastegate Control (TCWC) solenoid – Controls the TCWC actuator by regulating the amount of charge air pressure supplied to the TCWC actuator. The TCWC solenoid is controlled by signals from the ECM in response to engine speed, required fuel quantity, boost, exhaust back-pressure, and altitude.

Turbocharger 2 Wastegate (TC2WG) solenoid – Controls the TC2WG actuator by regulating the amount of charge air pressure supplied to the TC2WG actuator. The TC2WG solenoid is controlled by signals from the ECM in response to engine speed, required fuel quantity, boost, exhaust back-pressure, and altitude. The TC2WG actuator is part of the turbocharger assembly.

Turbocharger 2 Wastegate Control (TC2WC) solenoid – Controls the TC2WC actuator by regulating the amount of charge air pressure supplied to the wastegate actuator. The TC2WC solenoid is controlled by signals from the ECM in response to engine speed, required fuel quantity, boost, exhaust back-pressure, and altitude. The TC2WC actuator is part of the turbocharger assembly.

Variable capacitance sensor – A variable capacitance sensor measures pressure. The pressure forces a ceramic material closer to a thin metal disc in the sensor, changing the capacitance of the sensor.

Vehicle Electronic System Programming System – The computer system used to program electronically controlled vehicles.

Vehicle Retarder Enable/Engage – Output from the ECM to a vehicle retarder.

Vehicle Speed Output (VSO) – A vehicle speed signal sent to the EGC through the J1939 network.

Vehicle Speed Sensor (VSS) – Normally a magnetic pickup sensor mounted in the tailshaft housing of the transmission, used to indicate ground speed.

Viscosity – The internal resistance to the flow of any fluid.

Viscous fan – A fan drive that is activated when a thermostat, sensing high air temperature, forces fluid through a special coupling. The fluid activates the fan.

Volt (v) – A unit of electromotive force that will move a current of one ampere through a resistance of one Ohm.

Voltage – Electrical potential expressed in volts.

Voltage drop – Reduction in applied voltage from the current flowing through a circuit or portion of the circuit current multiplied by resistance.

Voltage ignition – Voltage supplied by the ignition switch when the key is ON.

Washcoat – A layer of alumina applied to the substrate in a monolith-type converter.

Water In Fuel (WIF) sensor – A switch sensor that measures the amount of water in the fuel.